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ABSTRACT

This document reports on an analysis conducted to find out how white-collar workers have been affected by the latest developments in computerization and how current changes influence work organization, personnel training, and skills. The document consists of an introduction, seven chapters, and an 18-page bibliography. The first chapter examines the impact of technology by comparing it with other factors of change. Chapter 2 considers key changes within the finance, retailing, and telecommunications service industries. The third chapter looks at the impact on work organization as it affects processing clerks and related office employees; engineers and draftspeople; typists and secretaries; and inventory control personnel. The fourth chapter discusses changes to skills and job content and reports changes in overall skill levels; in employment and occupational structure; in the content of individual worker's activity; and in the knowledge, know-how, abilities, and behavior required of the worker. Chapter 5 reports on the consequences for the workforce as to salary scales and job status; hiring standards; workplace locale; career ladders; layoffs, readaptation, and reassignment of workers; and the specific groups of people who seem to be most vulnerable to changes. Chapter 6 examines the three groups of factors (economic, social and institutional, and time) that explain the current changes. Chapter 7 lists general conclusions. (CML)

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THE EVOLUTION OF NEW TECHNOLOGY, WORK AND SKILLS IN THE SERVICE SECTOR

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THE EVOLUTION OF NEW TECHNOLOGY, WORK AND SKILLS IN THE SERVICE SECTOR

Within the CERI project "Changes in Work Patterns and their Educational Implications" a number of research studies of the development and use of human resources, with particular focus on skill formation, in the context of technological change and industrial restructuring have already been completed. Initially these were restricted to five large enterprises in the automobile industry and national developments in their respective countries. In the course of these studies the need became apparent to extend the enquiry into the "tertiary" sector to find out how white-collar workers have been affected by the latest developments in computerisation and how current changes there influence work organisation, personnel training and skills.

The study here presented attempts to do this, making use of the considerable body of research that has been done recently or is now in progress in a variety of OECD Member countries, and drawing on expert advice in a number of them.

The authors are M. Olivier Bertrand, CEREQ, France, and Mr. Thierry Noyelle, Columbia University, United States, who worked in close collaboration with the CERI Secretariat.

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INTRODUCTION

An overview of the tertiary sector

The word "tertiary" is ambiguous and no generally agreed definition appears to exist (Gershuny and Miles, 1983). However, the following observations should indicate how we wish it to be understood.

There is no doubt that the growing role of tertiary employment in the Western economies (see Table 1) is the reflection of a twofold qualitative change in the way these economies function -- namely change in what they produce and in how they produce. In terms of what the OECD countries produce, the shift towards services corresponds to changing consumer demand, often related to rising living standards. It is especially evident in the growth of such sectors as health, education, central and local government services and, to a lesser degree, retailing, entertainment, the hotel industry, etc.

In terms of how the OECD countries produce, the movement towards services-based economies reflects the powerful growth in what some authors call the "intermediate" services offered to producers (Stanback et al., 1983): not only the intermediate stages of distribution but also the development and financing of goods and services for final consumption (wholesaling, transport, telecommunications, research and development, banking, insurance, accountancy, consultancy services, etc). The phenomenal growth of "the tertiary within the secondary sector" and the trend towards externalisation of a number of activities once handled by industry itself and now "farmed out" (e.g. cleaning and maintenance, but also technical planning and computer studies) both form part of the same general trend. (Kempf, 1984; Les emplois tertiaires dans les entreprises industrielles, CEREQ, 1980; Stanback et al., 1983). A net effect of this is the blurring of the borderline between sectors.

The increasingly important role of these intermediate services is clearly brought out by a recent OECD study on the services' contribution to the growth of employment during the period 1976-1982 (OECD Employment Outlook, 1984, Chapter 3). Using an approach similar to the one described above, in which intermediate and consumer services are considered separately, the study reveals notably that on average and in all the OECD countries, it was the financial and business services that expanded the most over the last few years (see Table 2).

Table 1

SERVICES SHARE OF TOTAL CIVILIAN EMPLOYMENT
Percentages

	1970	1982
Canada	61.5	68.2
United States	61.1	68.0
Japan	46.9	55.4
Australia	55.0	63.7
New Zealand	48.6	55.7
Austria	43.2	52.8
Belgium	52.1	64.7
Denmark	50.7	64.0
Finland	38.6	53.0
France	46.4	57.2
Germany	42.9	51.8
Greece	34.2	41.9
Iceland	44.4	52.3
Ireland	43.1	51.6
Italy	40.3	50.6
Luxembourg	46.4	58.9
Netherlands	54.9	66.3
Norway	48.8	62.5
Portugal	37.1	37.0
Spain	37.4	47.8
Sweden	53.5	64.1
Switzerland	45.5	54.5
United Kingdom	52.0	62.6

Source: OECD Employment Outlook, Paris, 1984, Table 19, p. 40.

New technology contributes to these broad economic changes in a number of ways which we shall summarise before going on to treat them in greater detail. Firstly, the productivity gains generated by new technology lead to higher living standards and thus, indirectly, to altered consumer demand. Secondly, the productivity gains are such as to accentuate the shift from blue-collar direct production to the indirect white-collar activities of distribution, financing and development. In addition, computerisation increasingly tends to force both blue- and white-collar workers, through the use of automated equipment, to work with common "raw material", namely, information. In other words, computerisation draws ways of working and functions closer together (Metzner and Rohde, 1983).

Table 2

GROWTH OF EMPLOYMENT IN SERVICES, 1976-1982
(Average annual rate in percentages)

	All services	Financial and business services (ISIC 8)
Canada	2.8	3.3
United States	2.7	5.6
Japan	2.2	12.4
Australia	2.2	4.2
New Zealand	1.1	2.9
Austria	2.3	3.7
Belgium	1.5	1.9
Denmark (1)	2.7	3.2
Finland	2.4	2.7
France	1.6	2.5
Germany	1.5	3.5
Greece (2)	4.1	5.9
Iceland (1)	3.9	6.0
Ireland (1)	3.6	20.5
Italy (2)	2.6	7.2
Netherlands	2.9	7.3
Norway	2.8	4.2
Portugal (1)	3.5	3.8
Spain	0.4	1.5
Sweden	2.1	3.0
Switzerland	1.5	2.9
United Kingdom (1)	0.9	3.1

(1) 1976-1981
(2) 1977-1982

Source: OECD, Employment Outlook, Paris, 1984, Table 22, p. 42.

Thirdly, new technology can be said to usher in a new economic era in which large-scale production of highly personalised goods and services succeeds the period of mass production of highly standardised goods and services (but mostly goods).

Before concluding this brief account of the growing importance of the tertiary sector in the OECD countries, we should note that some authors refer to "the information society" rather than "the services society". Various studies have tried to calculate the number of "information-related jobs", that is to say, jobs concerned primarily with the processing of information. Depending on the country concerned, OECD put the figure at between 27 and 41 per cent of the labour force in the mid-1970s (OECD, 1981). Given the difficulty of classification, such estimates are very approximate, but there can be no doubt about the increasing role of information.

Scope and plan of study

Tertiary sector employment is extremely varied, not only because of differences between branches of activity, tasks and levels of responsibility, but also because of the varying degrees to which it is affected by the changes under way and, notably, the different ways in which new information technology is applied. This study therefore does not try to deal systematically with the changes occurring in every sector and every occupation, but rather to use typical situations to reveal certain broad tendencies.

The particular focus is, firstly, on changes in employment patterns in a limited number of major service categories -- finance, telecommunications, retailing -- and, secondly, on qualitative changes in certain occupational sectors involving large numbers of persons and functions -- office workers and secretaries, technical design staff working with computers, stock and production management personnel.

This twofold treatment (Chapters 2 and 3, respectively), together with the preceding Chapter 1 on current changes, their purpose and their effect on employment, is intended to emphasise the qualitative and long-term impact of these changes.

In this connection, the long-term view indicates that technological change will have effects much more sweeping than the immediate "production" benefits sought by users and will enable firms to redefine their markets from A to Z (which means redefining the ultimate aim of all the tasks involved) and will entail a complete overhaul of the traditional division of labour. As pointed out at the end of Chapter 3, it seems that there is now tremendous scope for new forms of division of labour different from the Taylorist models embodied in the mass production philosophy.

These considerations suggest three kinds of questions:

-- What skills are required for the new models of work organisation and job content?

-- What short- and medium-term consequences do these changes entail for workers, in terms of loss of jobs, reassignment or alternative employment, and of altered career ladders, recruitment thresholds, etc.?

-- What factors seem to delay or hasten the diffusion of new technology, not only as regards investment in hardware and software but also, more importantly, as regards the transition from old to new forms of work organisation?

These questions are examined in Chapters 4, 5 and 6, respectively. The study then concludes by suggesting a number of ideas as to how the need for training and wider diffusion of the new technologies can be satisfied, and raises a series of questions to which answers have still to be found.

Chapter 1

THE CHANGES TAKING PLACE: THE ROLE OF TECHNOLOGY AND ITS IMPACT

TECHNOLOGY COMPARED WITH OTHER FACTORS OF CHANGE

For some years now, the spectacular spread of new technology, especially the new horizons opened up by computerisation and automation, has so monopolised attention that one is tempted to see it as the determining factor in work, employment and vocational training. It should, however, be remembered that technological progress is only one of a wider set of changes, namely:

- The economic developments referred to in the Introduction, notably: fiercer competition, an ever-shorter innovation cycle, higher quality requirements and the quest for more efficient management;
- Socio-cultural changes linked to workers' improved educational level and rising expectations.

These changes influence work organisation and labour management, as does technology, in the direction of greater adaptability and flexibility. There is a movement towards increased participation, so that the work force feels more motivated and aware of corporate goals, more concerned with the results of management and more responsible, for quality standards in particular.

Technology plays a part in this process. It can be used to devise new products and methods of production. It may (or may not) go hand in hand with changes in organisation aimed directly at economic viability and/or fulfilling social needs that may indirectly affect viability.

The relations between these factors are neither rigid nor unidirectional: the personnel available in a company or on a labour market, the kinds of skill produced by a given social or educational system may determine forms of organisation and even influence the choice of technologies.

We, like most other authors, feel therefore that technology is a potential force that can serve a variety of projects and policies under conditions that differ according to country, sector and corporate context. This basic assumption will be reassessed in a final chapter in the light of observed experience.

THE NEW TECHNOLOGICAL POTENTIAL

The history of technology, as it has affected tertiary employment, may be summed up in the following table devised by the manufacturing firm Hewlett Packard:

Category of Personnel	Office equipment			
Professional	Telephone (late 19th C)	Pocket calculator (1970)		Personal computer (1980)
Secretaries	Typewriter (1920)	Copier (1950)	Electronic typewriter (1970)	Word processor (1980)
Clerks	Specific computer applications (1960-1980)			

According to Hewlett Packard, the epoch now dawning is completely different, in that integrated systems will henceforth supersede compartmentalised technical innovations.

The computer is obviously the oldest and most widely used product of the "new" technologies. However, it has come a long way since its beginnings:

-- From off-line (with a physical information medium) to on-line (with conversational (mode) screen and keyboard);

-- From large centralised mainframes to widely dispersed mini- and micro-computers;

-- All this at increasingly low costs.

The computer may be linked up with a variety of devices, providing, for example, word processing or computer-assisted design (CAD), which will be discussed at a later point.

The possibilities opened up by developments in telecommunications (teleconferences, networks, etc.) have been thus far underexploited so that it is still too early to assess their potential impact, especially as their main effect may well be on organisation and behaviour rather than on individual job content.

The change in future outlook brought about by the most recent advances in computer science, of which real time and miniaturisation are only two aspects, cannot be over-stressed. To quote Glenn and Feldberg: "The term office automation has taken a new meaning. Originally, the use of computers to perform routine clerical tasks ... was viewed as the culmination of technical developments that began with the typewriter, the adding machine and other simple machines. Now, however, the use of computers for routine tasks is looked upon as merely laying the groundwork for true office automation" (in Zimbalist, 1979). Four considerations appear to typify the current trend (see Hirschhorn, 1984):

a) The growing importance of software as compared with hardware, and the consequent extension of computer applications to many other areas and tasks, along with a shift in employment demand away from electronics and towards computer expertise.

b) The flexibility offered by computer systems, enabling service enterprises to adapt their "product" to market fluctuations and to particular client requirements, and so respond to the economic imperatives referred to above. Like its counterpart in industrial automation, this trend is significant because it breaks with the logic of repetitive mass production and can thus affect work organisation.

c) Computerisation is leading to increased integration of different functions. Integration of the various large and small computer facilities is also taking place (including word processing for different classes of user). Here again, technical potential coincides with economic demand. Whereas the sporadic automation of the first phase of the computer revolution had only a limited impact on products and the division of labour, the new computerisation takes the form of integrated automation and may lead to sweeping changes in both products and the division of labour.

d) More highly qualified personnel is in demand as the computer systems become more "intelligent" (expert systems capable of helping in problem analysis and decision-making).

The logical outcome of these developments is for computer systems to move from the fringes of the production process to the centre. On the other hand, the computer services themselves are tending to lose their former monopoly. Interactive systems connected to larger units now enable users to satisfy their own needs.

Taken along with similar features of industrial automation, the above considerations entail specific consequences and, in particular, simultaneous changes affecting the product resulting from computerisation, the method of production, and the corresponding organisation.

A final phase of the transformation could be more work at home by means of a computer link with the enterprise or institution. Technically feasible and already in use, it is still too rarely practised for any opinions on its implications to be formed.

USE AND DISSEMINATION OF NEW TECHNOLOGY

The new technological potential is spreading very unevenly depending on function, enterprise, sector and country and we will return to this point in Chapter 6 and the Conclusions.

In the beginning, computers were used for the most structured and repetitive tasks within an enterprise, those involving formal procedures, such as book-keeping and invoicing. In the following phase, they were given less structured applications in sales, pricing and transport (A. d'Iribarne, 1983). Today, computer operations can encompass simultaneously, and integrate: the provision of customer (front office) and internal administrative (back office) services; conventional tertiary and industrial applications (design and flow-charting, as well as production control and follow-up); routine tasks as well as much more complex executive-style work.

It must be emphasized, however, that this potential is very unevenly exploited. Although the above summary of developments in technology and their possible and actual applications reveals a major trend, the real-life situation of very many enterprises leaves much to be desired. While it is true that the technical conditions exist for a swift and thoroughgoing revolution, many observers feel that genuine change is often slow in coming (Pape, in Fossum, 1983; Lowstedt, 1984; Pomfrett, 1984; Stymne, 1983; Hayes, 1980). Some commentators (Grünewald and Koch, 1981; Appelbaum, 1984) believe that the fundamental concept of integration itself remains a theoretical possibility rarely put into practice and fraught with formidable obstacles.

Some authors are also of the opinion that many tertiary activities are difficult to computerise (or automate), either because they are less predictable or "modelable" than industrial activities or because computerising them would not be worthwhile -- as is the case with typewriters used only occasionally (Fossum, 1983; Grünewald and Koch, 1981; Metzner and Rohde, 1983).

Admitting that these arguments are still valid in the light of recent changes (which is debatable), the important point no doubt lies elsewhere. As a Swedish study on banking (Arbetsmarknads-Departementet) indicated, the technical solutions of the 1980s were already available in the late 1970s; but technology takes second place to non-technical problems when it comes to putting these solutions into practice.

To a large degree, the problems are human and they form part of the main subject of our study. The dissemination of new technololgy and its efficient utilisation may be said to depend on:

- -- The degree of inertia of organisations;
- -- The priority assigned to maintaining the employment level and existing work organisation;
- -- The attitude and policies pursued by unions and management.

These factors are in turn linked to the specific context of individual countries (employment structure, worker status, social relationships, role of the trade unions) and the way enterprises introduce new technology and prepare their staff to use it.

These questions are central to our study and we shall come back to them, but some economic factors should be recapitulated first.

ECONOMIC OBJECTIVES AND THE PROBLEM OF PRODUCTIVITY

Improved productivity, that is, the relation of output to the quantity of work, is the first objective which springs to mind, all the more so since over the decade 1974-1983 the economic productivity of most industrial countries slowed down markedly. The slowdown has been attributed in part to the growth of tertiary activities whose productivity rose more slowly than that of other sectors. This gave rise to the idea that future productivity gains should be looked for in the tertiary sector, with new technology making a major contribution, especially by automating a number of operations in order to save manpower.

Word processing was one particular method envisaged for reducing secretarial costs. But according to one American cost study, secretarial costs represent only a small fraction (6 per cent) of non-manual labour costs, with typing accounting for only 20 per cent of that figure, that is to say, 1.2 per cent of the total (Uhlig et al., 1979). This being so, productivity gains would have to come from professional staff rather than from typists.

This raises the question of whether such gains can be evaluated. Does the very term productivity have any meaning in the tertiary context? There is a general problem with measuring the productivity of services. One has only to realise that, since many services act only as inputs for other activities, the productivity gains of one sector are often attributed to another (Stanback et al., 1983). Even in branches where the product of a tertiary activity can easily be identified and quantified, as in word processing, the studies arrive at contradictory conclusions, and it can be seen that comparisons of the numbers of lines typed are not significant over a long period (Uhlig, 1979). Moreover, computerisation often leads, not to a lowering of the quantity of labour required, but to an increase in the amount of information needed and produced (Glenn/Feldberg in Zimbalist, 1979). Is it possible in such a situation to talk of productivity gains?

In fact, analysis of changes in the work-to-product relation assumes the product to be constant. But, as we have seen, not only is it difficult to define the product of a tertiary activity, but above all new computer technology makes it possible to transform simultaneously both product and method of production. Instead of the usual appraisal of the production process by referring to the product, it is now becoming necessary to reappraise the product according to how production technology is utilised. This in turn calls organisational logic into question. When comparing costs and results, the whole "product-method of production-organisation" complex must be considered, and many of the traditional criteria for measuring productivity become irrelevant.

While there are almost insuperable obstacles to forecasting productivity gains, numerous special studies of results obtained within certain work sectors or enterprises, in the United States particularly, report spectacular reductions in manpower or rises in output (West, 1982).

However, the benefits expected from new technology do not end there (1). New technology can also help to:

-- Invent *new products* that are often more elaborate, diversified and better *adapted to demand* (e.g. by using CAD for industrial products, or the latest computer systems for insurance policies and financial products); or modify existing products (CAD for industrial products);

-- *Save time*, an important factor in competitiveness, in the design and *development* stages (especially by using CAD in industry);

-- *Improve product quality and dependability*, by means of checking and simulation procedures in CAD and computer operations, rereading before printout in word processing;

-- *Improve management* generally, thanks to clearer, more exact, frequent and abundant information, leading to improved cost control (inventory rundown, regularity of supplies in production management);

-- Lastly, *improve communication* within the enterprise, while putting a check on the amount of paperwork produced and circulated (2).

The relative weight of these various desiderata cannot be easily evaluated. In the case of Germany, Grünewald and Koch (1981) estimated cost reduction at 58 per cent, improved quality at 15 per cent, higher production capacity at 10 per cent, and reduced manpower at 2 per cent. In Japan (JIOA, 1983), the search for greater productivity was rated at 42 per cent, the desire to automate routine tasks at 19 per cent, speed and dependability at 15 per cent.

The fact is, in the view of many observers, that enterprises are often incapable of evaluating their own needs, that they have no clear and consistent idea of the equipment needed and its utility (Pomfrett, 1984), and do not carry out preliminary efficiency studies. Even in Japan, enterprises often confess themselves incapable of measuring the volume and efficiency of office work (JIOA, 1983).

Some authors (Samson, 1983) consider that manpower reductions are sought only "in branches such as banking and insurance where the computer becomes a production tool in the same way as machines in the production of tangible goods. In other branches, it is sought in order to increase competitiveness in a large variety of ways." Other commentators (Metzner, 1983) interpret the manpower reductions observed in many large offices as a consistent policy objective on the part of enterprises.

THE IMPACT ON EMPLOYMENT

This analysis of the problems of evaluating productivity gains could be enough to discourage attempts at forecasting the impact of new technology on employment. Yet, at a time of slow growth and high unemployment, the problem of jobs is an aspect of the situation which most concerns governments, workers and trade unions and to which a large number of studies are devoted. For the EEC countries alone, the number of such studies was recently reckoned to be about one hundred (Europe 1995, FAST Report). A comparison of some of them (see OECD, 1981; Missika, 1981; Attewell, 1983) reveals the diversity, not to say the incompatibility, of their findings. This is largely due to the complex nature of the problem, which does not seem always to have been clearly grasped.

Put briefly, some studies conclude that the new technologies have a negative overall impact, others that they have a positive impact, and others again that the findings arrived at are necessarily inconclusive.

Among the authors whose pessimistic forecasts predict a negative overall impact, we find some equipment manufacturers (e.g. Siemens, 1976) who were thus able to demonstrate new technology's capacity to bring about productivity gains; but above all trade unions and their experts, (APEX, 1980; Metzner, DGB, 1983; Cooley, Int. Metalworkers Fed., 1984), are worried about the risk of fuelling unemployment. Also, economists like Leontief (1984) predict a decline in overall employment.

Other studies, together with various official surveys, reach the conclusion that impact by sector may be negative, but that overall impact may be positive. Some recent work devoted more especially to tertiary activities finds that earlier estimates greatly overstated the quantitative impact of technological change and its speed of dissemination because they underrated social factors. It is probably no coincidence that the authors are European and not American -- a point we shall return to (Pomfrett, 1984; Stymne, 1983; Fossum, 1983; Whitley, 1982; Bird, 1980).

Finally, recent official reports (in France, "Informatique et emploi", 1984; in the United States by the Office of Technology Assessment) corroborate previous research (such as that of Appelbaum, 1984; or Arnold and Senker, 1983) in finding that there is no observable global correlation between the extension of computerisation and the volume of employment, and that quantitative evaluation of the impact of new technology is impossible.

It should not be forgotten (Missika, 1981; Attewell, 1983) that estimates are largely conditioned by:

- The method adopted (model or survey of enterprises);
- The time frame (medium or long term);
- The definition of the field of enquiry: branch, type of application (microelectronics, computers, office automation, more or less broadly defined);

-- The level of enquiry: function, enterprise, sector, country, world.

All things being equal, which they rarely are, it might possibly be claimed that the impact at enterprise or sector level is often negative. At the general level, the problem seems even more complex. We believe, however, that technology has much less impact than economic fluctuations. Such a conclusion lends weight to Shaiken's remark (in Gregory and Marshall, eds., Office Automation, 1983) that for the first time technological change was occurring in a context of economic stagnation.

Like Metzner and Rohde (1983), the EEC FAST Report (Europe 1995) concludes that the fundamental feature of new technology has less to do with the overall level of employment than with the displacement of employment: technological change eliminates jobs in one place and creates them in another. This analysis is supported by the Japanese viewpoint, which stresses that, although the overall impact on employment may be minor, the effect of technological change becomes much more evident when particular localities, establishments, occupations and job categories are examined (3). This finding, emphasized also by American research (Noyelle and Stanback), persuades us to make the transition from a quantitative to a more qualitative approach.

Chapter 2

RESTRUCTURING IN THREE SERVICE SECTORS: FINANCE, RETAILING AND TELECOMMUNICATIONS

The following two chapters examine key changes in service employment set in motion by the introduction of new technologies. This chapter looks at the broad transformation of employment systems within three groups of service industries: finance, retailing and telecommunications; the next, at the impact of technological change on work organisation as it affects four major occupational groupings: processing clerks and related back office employees, engineers and draughtsmen, typists and secretaries, and inventory control personnel. The level of analysis is function, rather than industry. The first two of these four occupational groups are found primarily in financial firms and in the engineering offices of manufacturing firms, respectively. The latter two groups tend to be found across a broad range of both goods and service industries.

FINANCE

The financial sector, which includes commercial banking, the savings and insurance industries, investment and merchant banking, and a number of allied industries, offers some of the most typical and revealing examples of large-scale technological transformation in service organisations. Indeed, of all the service sectors, the financial sector has, thus far, been the most extensively studied, largely because it is there that some of the earliest and most widespread changes have taken place. See among others the works of Glenn and Feldberg in Zimbalist (1979), Adler (1980), Oberbeck (1983), Verdier (1983), Pastré (1983), Kirchner (CEC, 1983), Reuter (1983), Frey (1984), Rajan (1984), Cossalter and Hézard (1983), Appelbaum (1984), Cossalter (1984), Hirschhorn (1984) and Noyelle (forthcoming).

Taylorism reached the financial industries later than most manufacturing industries. Nevertheless, the impact of this particular phase of rationalisation was felt in the processing offices of banks, insurance companies and other firms in the industry typically well before the introduction of the first computers -- usually during the phase of office mechanisation characterised by the introduction of typewriters, mechanical calculating machines or even card-operated accounting machines.

The introduction of the first generation of commercial computers during the 1960s reinforced both centralising and Taylorist tendencies at work. On the one hand, partly due to the technical complexity of the technology itself, the introduction of the computer necessitated the creation of centralised systems divisions to develop and operate particular applications. This resulted in the centralisation of major functions such as accounting, book-keeping, or general ledger, leading typically to a decrease in the autonomy of departments and branches. As several authors have observed, in banking for example, the centralisation of book-keeping and accounting responsibilities often lead to a loss of marketing autonomy on the part of bank branches, an autonomy which is only now being returned to them in part as a result of advances in distributed data processing (Hirschhorn, 1984; Noyelle, forthcoming). On the other hand, the first generation computers often accentuated Taylorism as statistical and computational tasks were being eliminated by the technology, giving rise, however, to a need for extensive, tedious, repetitive keying work done by pools of lowly-skilled clerks. There is no doubt that the first phase of computerisation resulted, for some at least, in considerable deskilling.

While the 1960s represented a period of brisk expansion under conditions of low inflation and low interest rates for the financial institutions of most OECD countries, the 1970s saw the development of very different markets characterised by high inflation, high interest rates, near saturation for traditional financial products and intense competition, with a tendency towards the blurring of institutional lines as different segments of the industry fought over the same consumer dollar.

Within this context, the introduction of on-line, real-time, distributed data processing technology in the mid-1970s made possible a number of developments which, ultimately, began altering the way work is organised in financial industries. These developments are:

-- The introduction of far more flexible financial products, characterised by greater adaptability to rapidly changing monetary and inflation rates and offering far greater potentials for customisation in response to intensifying competition. These new products require widely expanded computing capacity for processing purposes, and demand far more interactive technology so that consumers, themselves or through their service agents, may enjoy the benefits offered by these products.

-- A reversal of earlier centralising tendencies and a decentralisation of certain accounting functions (e.g. agency and branch accounting), through the decentralisation of processing power. Not unnaturally, this development calls for a weakening in the role of the systems division, leading at times to serious conflicts within organisations (Hirschhorn, 1984; Cossalter and Hézard, 1983, and others);

-- The geographical decentralisation of processing functions traditionally attached to head offices or to branches (policy rating, claim processing, credit card processing, loan processing, etc.) to large back offices in peripheral locations.

- -- The beginning of an integration of the computerised systems being developed to assist the three levels of the organisation -- back offices (bulk processing), front offices (selling) and corporate offices (managing and planning).

The implications for most organisations are as follows:

- -- At the level of individual work, interactive technology redistributes much of the keying of data -- e.g. through customer-operated Automated Teller Machines, through on-line terminals operated by branch personnel, and so forth -- and decreases enormously the relative importance of this function. In addition, the development of more sophisticated software makes possible the reintegration of many tasks leading often to relative upskilling (see next chapter);

- -- At the level of functional emphasis, the productivity gains made possible by the new technology in back offices contribute to the relative shifting of personnel to front offices. This tendency is reinforced by the very nature of the technology itself, which by making customer records now directly available to sales personnel adds to the emphasis on selling and customisation. As Hirschhorn (1984) notes, the main tendency is for "bank personnel to be increasingly deployed to sell bank services rather than process banking papers";

- -- Thirdly, as suggested earlier, the redistribution of many accounting functions at the subunit level makes for a general across-the-board increase in personnel awareness of managerial and sales functions. This ultimately contributes to increasing overall organisational flexibility.

A legitimate question to ask at this point is what appears to be the aggregate impact of these trends on type and level of employment in the financial industries. In general, the findings are markedly similar from country to country. There is a shift away from employment of processing personnel towards employment of marketing and sales personnel. In the insurance industry, the general tendency is towards absolute employment declines among processing staff beginning in the mid-1970s. This is true in North America (Appelbaum, 1984; Noyelle, forthcoming), in the Scandinavian countries (Hafström, 1984), and many other European countries. In commercial banking, where the relative importance of processing staff has traditionally been lower than in insurance, the recent tendency is for a slowing down or a halt in the growth of banking personnel, in association with continued large increases in output level. Only in some sub-industries, such as security brokerage in the United States, do we witness large personnel increases because, despite tremendous investment in labour-saving technology, the pace of output growth is such that personnel must be added in large numbers (Noyelle, forthcoming).

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RETAILING

Even though the transformation of this sector may be less widely appreciated, retail underwent major changes in most OECD countries throughout the post-war period (Bluestone et al., 1981 for North America; Coryns, Child and Loveridge, 1983 for the United Kingdom and Europe). Many of these changes resulted from rising standards of living, spurring new demand and a shift in the location of that demand towards the suburbs. In effect, suburbanisation often fuelled the growth of chain stores and multi-unit operations. Trends towards increasing industry concentration, market competition and market segmentation became widespread, even though the timing may have differed from country to country, with European economies often following rather than leading the United States. Only in Japan would it seem that retailing has remained dominated by small independent firms, with still limited tendencies towards extensive market segmentation. Even though many of the changes undergone by the industry have had little to do with technology, they do set the context within which technological change has taken place in recent years (Bluestone et al., 1981; Noyelle, 1983a).

In employment terms, the impact of post-war changes was twofold. First, changes in work habits and spending patterns (e.g. two-worker families) led retail organisations to stay open a greater number of hours, through more extensive use of part-time employees. There does remain a great deal of variation, however. In Austria, for example, the law continues to restrict the opening of most retail businesses on weekdays from 9.00 a.m. to 6.00 p.m. and on Saturdays from 9.00 a.m. to 12.00 noon. In the United States most states have lifted so-called "Blue Laws" restricting opening to certain time slots, although in some states this occurred only in the late 1970s (most of these laws dated from the prohibition period). Nowadays in the United States, department store organisations are typically open 65 hours a week (10 hours on weekdays and 7 1/2 hours on Saturday and Sunday) and, in many cities, supermarkets are now competing on a twenty-four hour basis. In terms of use of part-time work, the results have been dramatic. For example, U.S. department stores have completely reversed the old breakdown between full-time and part-time sales employees, from 65 per cent full-time/35 per cent part-time employment two decades ago to 35 per cent full-time/65 per cent part-time nowadays.

Second, the emergence of large chain organisations and the resulting shift in scale of operations permitted considerable rationalisation and major productivity gains on the buying, inventorying and accounting side of the retail business, making it possible to run very large sales organisations with relatively thin administrative staff (Noyelle, 1983a).

Large retail organisations began using computer technology almost from the beginning of the commercialisation of large mainframe computers. The sheer numbers of items and transactions needing to be recorded long put a premium on technologies that could assist these areas of work. Yet until the mid-1970s, the technology available permitted little else but "punctual" automation, mostly in areas of simple inventory control and accounting. In the United States, for instance, even though large department store chains like J.C. Penney were already experimenting with on-line cash register terminals back in the late 1960s, the technology available at that time permitted little flexibility. These were essentially dumb terminals, meaning that when the central computer was down the entire system was down, making it impossible for salespeople to record transactions. Consequently, most companies continued to rely on the old-fashioned mechanical cash registers, or on their most advanced version that produced a ticker tape that could be fed at the end of the work day to a computer-like machine (4).

The introduction in the late 1970s of advanced electronic cash registers linked on-line to mini- or mainframe computers represents a major departure, however. The capacity for keying data on stock items and financial transactions directly at the point where the transaction occurs (i.e. the sales floor) is not simply changing somewhat the job of the salesperson, but, more importantly, is changing fundamentally inventory functions, "merchandising" (or buying) functions, the linkages between the firm and its suppliers, and account-processing and marketing functions (Noyelle, 1983; Noyelle, 1984).

On the sales floor, these new systems make it possible, for example, to determine the stock-room availability of items missing on the shop floor, or to check the credit of customers using charge accounts. Hence, these systems permit more sophisticated customer service, for example through a more extensive use of charge accounts over which they permit better control. In addition, these systems make possible the development of statistical profiles of floor traffic (per hour of the day, per week of the month, per month of the year) allowing store managers to staff their sales floor better. Of course, sales floor staffing remains fundamentally determined by many factors other than technology, having to do with the particular market strategy of the store itself (greater reliance on self-service or greater reliance on customer assistance).

To a large extent, however, the greatest impact of the new on-line, P.O.S. (Point of Sale) technology is indirect, taking place at the "back of the store". The first area where change is being felt includes functions of inventory control, stores stocking and warehousing. Because of vastly improved inventory control methods made possible by the new technology, firms can now introduce just-on-time procedures for shelf stocking and do away with the need for extensive stock-rooms in the stores themselves. Departments are now stocked directly from the warehouses themselves, with stores devoting minimum space and work force to receiving and stocking areas. J.C. Penney in the United States estimates that the shift to on-line inventory control in stores and warehouses has permitted it to bring down the average number of in-store stock clerks from between 20 to 30 people to about 1 or 2 employees per store! In addition, the average ratio of selling space to total floor space has gone up, from roughly 55 per cent to about 75/80 per cent nowadays in the case of the U.S. department store industry, largely as a result of the elimination of stock room space.

The second area affected by advanced computerisation is merchandising (buying). Until the advent of the new, vastly expanded, inventory control systems, a good part of the buyers' job involved keeping track of how fast product classifications were moving through the shelves of departments. Most often, this meant outguessing what was really happening, since inventory clerks could not produce the information that was needed at the speed which was demanded. In short, "buying" had to be intuitive. Today's on-line systems permit buyers to have up-to-the-minute information on every single product classification and the speed at which each is selling, hence to obtain information on which they can evaluate the need for reordering. As a result, buyers can now spend more time on the merchandising function per se, i.e. searching for new goods, while computerised systems do much of the work involved in keeping track of what is happening on the sales floor.

Along with vastly improved systems to identify buying needs, retail organisations are now developing automated ordering systems which link their buyers directly to their suppliers. This third area of transformation is important in two ways. From the point of view of retailers, it makes it possible to refine still further the introduction of just-on-time delivery systems. From the point of view of suppliers themselves, it forces them to get involved in the new technology. The very success of Benetton -- the Italian retailer of knitwear -- can be largely attributed to such a system:

> "In large measure, the company's success in Europe can be traced to the efficiency of the computerized inventory system which, in linking the stores, provides immediate intelligence reports on shifts in what the customer wants, enabling the company to make immediate adjustments in production. [...]
>
> Much of Benetton's knitwear is produced in neutral gray so the company can quickly dye it in any of 60 hues according to changing customer demand [...]
>
> It farms out much of its work to small suppliers, about 200 of them in villages nearby Treviso (the Italian headquarters of the firm), whose non-union wages and low overheads keep production costs low and offer insulation against labor troubles.
>
> Benetton's clothes are created on state-of-the-art computer-aided design terminals and woven on micoprocessor-controlled looms. Its vital electronic inventory system, which tracks stock across Europe to a central computer, may soon be linked with Washington and Tokyo by satellite." (New York Times, 25th September 1984).

Likewise, large U.S. retailers such as J.C. Penney and Sears have computerised systems which link them directly to their major suppliers.

The fourth and final area indirectly affected by the introduction of on-line P.O.S. technology is the whole domain of general accounting, account receivable/account payable, billing, customer credit and the like. Very simply, large retail organisations are eqipped with back offices not unlike those found among insurance firms or banks. By distributing much of the keying of data to the sales areas, smart on-line P.O.S. technology makes possible, in the back offices of the large retailers, a transformation of work organisation similar to that occurring in the financial sector, and examined in greater detail in the next chapter. In the United States, for example, Sears and J.C. Penney, the two largest chains of department stores, each with nearly two thousand stores nationwide, both employ several thousands of people to handle these functions. It comes as no surprise to learn that these two retailers are often among the most advanced users of back office technology. Indeed, for several years now, Sears has been selling back office processing services to several very large U.S. banks. Ultimately, however, what these developments reveal are attempts by very large retail organisations to put in place extensive computer-telecommunication infrastructures, which permit them to do high volume, low-cost transaction transfer and transaction processing and which, once associated with traditional and/or new distribution channels, form the backbone of advanced distribution networks which can be used to serve almost any consumer need, ranging from cars and washing machines to consumer banking services or insurance policies. Witness the fact that Sears' financial assets in its insurance, savings bank, security brokerage and real estate brokerage subsidiaries make this number-one retail distributor one of the top 20 largest financial firms in the United States! (New York Times, 12th January 1984).

TELECOMMUNICATIONS

The telecommunications industry, as most OECD countries have known it over the past eighty years or so, is fast disappearing. What is emerging is a new industry in which the demand for services has changed, being no longer limited to voice telecommunications but increasingly expanded to include data and image transfers. This qualitative transformation, as well as the surge in demand for the three basic services -- voice, data and image -- are forcing regulators in most OECD countries to change the way the industry is regulated, typically by opening up the old public- or private-sector monopolies to some form of competition either on the equipment side (telephone instrument, telephone/data terminals, PBXs and large switches) or on the service side (long-distance carriers, voice and/or data local area carriers, cable operators, etc.). The United States have gone the furthest in the direction of deregulation. Japan is poised to privatise N.T.T. in early 1985 and deregulate the industry thereafter (5). European countries are holding on tighter to their old PTT structures, even though most have considerably expanded their telecommunications service offering (Noyelle, 1984).

Surge in demand, qualitative changes in demand, increasing competition are all factors which are forcing the industry to make major changes in production technology. This is being done through the widespread introduction of the computer, both as switching device to replace the old electromechanical switching systems and as an office automation device to reorganise billing, sales and engineering functions.

The impact of this technological revolution, which began in earnest in the late 1960s and early 1970s with the introduction of the first generation of electronic switching systems, has already been dramatic, affecting at once almost every major occupation in the industry. Data gathered in the United States by Northrup and Larson (1979) for AT&T company for the period 1973-1979 and summarised in Table 3 help grasp the extent of the change under way.

While total employment remained constant throughout the six years, the number of telephone operators declined drastically (-28 per cent), that of blue-collar workers and technicians ("outside craft": people installing lines and telephones; "inside craft": people installing and fixing switches) remained stable, that of clerical staff grew very slightly and that of

Table 3

CHANGES IN AT&T LABOUR FORCE
31st DECEMBER 1973 TO 15th JANUARY 1979

	1973	1979	Rate of change
Officials, Managers, Professionals and Sales	201 611	234 348	16.3%
Clerical	231 464	242 209	4.7%
Switchboard Operators	143 918	102 654	- 28.7%
Outside Crafts (see text for def.)	136 391	135 072	- 1.0%
Inside Crafts (see text for def.)	97 198	97 569	0.4%
TOTAL	810 582	811 852	0.2%

Source: Herbert R. Northrup and John A. Larson (1979).

officials, managers and professionals grew sharply (+16.3 per cent). This same period saw an increase of nearly 60 per cent in the yearly number of phone calls, translating into an approximately 50 per cent increase in productivity measured in constant dollars of operating revenues per employee for the period (Noyelle, 1983b). Only in the late 1970s and early 1980s did there seem to be a slowdown in these productivity increases, in part due to the beginning of a stronger resistance on the part of unionised employees most directly affected by the changes.

The impact of the new telephone technology is being felt in various ways at various levels.

The nerve centre of the telephone system is the central office with its switch. Switches route phone traffic through the network. The earlier electromechanical switches were equipment that needed considerable routine maintenance. In the United States, in large central offices the phone company used to employ on a daily basis upward of thirty or forty technicians to maintain and repair switches. The job of switchmen, the principal line of inside crafts, entailed electrical and mechanical skills for repair as well as analytical skills for diagnosis purposes. Electronic switching uses electronic circuitry and computer technology to do traffic routing. Today's electronic switches handle about 550 000 calls an hour, four times as many as could be handled with the most advanced electromechanical switches. The need for diagnosis and troubleshooting is largely engineered into the equipment itself and the need for maintenance has been considerably reduced.

Maintenance now mostly entails trouble-identification through CRT (Cathode Ray Tube) monitoring and the replacement of malfunctioning circuit packs with new ones. The result is that, following the introduction of new generations of electronic switching, the number of switchmen in central offices has come down to about two or three. Typically such reduction has been accompanied by a reorganisation in the way maintenance is organised, through centralisation of both the switching control functions and the repair functions in centralised switching control centres, where switchmen monitor several switches at once and can dispatch repair persons as needed (Noyelle, 1983b; Newman, 1981).

The second area directly affected by the new technology has been operator service. With highly automated switches, assistance work for the operator now requires pushing buttons on a console rather than plugs. More importantly, the new consoles do computerised toll calculations and record-keeping. Not so long ago these operations were done manually by operators themselves. Not surprisingly, then, the new technology has sent productivity soaring from an average of twenty assisted phone calls per hour per operator with the old cord board to today's one hundred calls per hour! [which means spending an average of thirty-five seconds or less per call!...] This is the one area of work in which excessive Taylorisation and sharp deskilling can be claimed, suggesting that perhaps the best way out of such a bind will only come through full automation of the operation function, which is indeed the way the new long-distance phone companies in the United States (MCI, SPRINT and others) have organised their system.

This last observation raises a much broader issue concerning employment levels among craft workers and operators. Somewhat paradoxically, it is those countries (or those firms) which historically have had the most developed communications systems that are now stuck with the worst employment problems, because these earlier systems were based on labour-intensive electromechanical technology and because they must continue to carry on their balance sheet investments with a twenty to twenty-five years write-off period. The United States, Japan or England appear to be experiencing some of the greatest adjustment problems, whereas France and Germany, which developed their systems much later, seem to be now benefiting tremendously from their lateness. For example, France can easily move ahead with the development of a computerised directory assistance system based on its MINITEL teletex system, since it never had a human directory assistance system to speak of, whereas Japan is worried about following through with such computerisation, since it uses directory assistance positions to relocate operators displaced from the central offices (Noyelle, 1984b).

Likewise, system-wide NT&T in Japan or the old AT&T in the United States are less than 50 per cent upgraded to electronic switching, whereas newer systems in Switzerland, Germany or France are nearly 3/4 modernised.

Other areas affected by extensive computerisation are the supporting areas such as billing, accounting and others where the growth in number of clerks has been held in check, while those functions have become far more developed and sophisticated than in the past, both from the point of view of the telephone companies Management Information Systems (MIS) and the point of view of the information made available to the consumer himself.

Indeed, as we find in other industries, many of the changes that have occurred in the basic telephone technology are helping the telecommunications industry shift human resources away from direct production of the service itself -- at least in terms of the sheer number of employees -- towards engineering and/or sales functions, that is, towards personnel employed either in conceptualising the new systems or in reaching out to the consumer. These are two functions that have become increasingly necessary in the face of rising competition and growing sophistication in the service made available nowadays.

All in all, it would appear that it is among outside craft workers that changes brought about by computerisation have been relatively less pronounced, even though other technological advances (plug-in modular equipment, fibre optic cables) have changed some of the functions traditionally handled by those crafts.

CONCLUSION

These short reviews of technological transformation in three groups of service industries have simply attempted to suggest that change is often more widespread than is assumed. These reviews have purposely overlooked differences in the rate of diffusion of the new technology and purposely left aside a more detailed analysis of the very direct impact of the new technology on work organisation. Differences in rate of diffusion remain great, especially in retailing, whether it be by size of firm or by country. The lack of extensive and/or comparable sector studies make a careful analysis of such differences difficult to carry out. In Chapter 6 of the study we return to this issue, however, and attempt to assess some key factors that may explain some of these differences. In the next chapter we return to the most immediate issue of the impact of the new technology on work organisation.

Chapter 3

CHANGES IN WORK ORGANISATION: OFFICE WORKERS, ENGINEERS AND DRAUGHTSMEN, SECRETARIES AND TYPISTS, PRODUCTION MANAGEMENT STAFF

OFFICE WORKERS

In assessing some of the broad shifts resulting from the latest wave of technological change, the previous chapter gave strong hints to the effect that the rationalising process associated with this new wave of change was different fundamentally from the Taylorist type of rationalisation characteristic of earlier eras. In this section we take a closer look at this issue by studying the direction of change in work organisation for the whole class of personnel found primarily in the back offices of financial firms but also in many other firms in the service sector of the economy.

Reviewing a wide range of work settings including insurance policy preparation, insurance rating, claim examining in insurance, fund transfer, letter of credit preparation, loan rating, lock-box services in banking and other back office operations, a number of authors concur in their assessment of the impact of computerisation on these functions and on employment related to them (Applebaum, 1984; Hirschhorn, 1984; Noyelle, forthcoming; Adler, 1983; Cossalter and Hézard, 1983, etc.). Their findings can be summarised roughly as follows:

-- At the lower end of the work process, on-line computerisation redistributes a good deal (if not all) of the data keying away from the processing office back to where the transaction originates, thereby decreasing the relative importance of this very simple function. Furthermore, the direct keying of data through a keyboard and a terminal with editing capacity enhances productivity tremendously compared to earlier card-punching methods of inputting. This redistribution of the keying functions is done through peripheral terminals and means that the insurance broker or the insurance agent enters the data directly into the system (rather than on a piece of paper, later coded and entered), or the customers do the keying work themselves. In general, computerisation means elimination of many paper files. The overall impact is a tremendous reduction -- if not complete elimination -- of many of the lowest clerical positions in back offices: messengers, file clerks and data-keying clerks;

-- At the higher end of the work process, the computerised systems that are being put in place make possible the elimination of some skilled functions that used to be handled manually, and a shift in focus of the work process around slightly different functions, often involving a closer rapport between clerks and customers (typically via telephone). For example, in the insurance industry, raters (people who used to calculate insurance policy rates) have been made largely redundant by the new softwares built into computer systems. The end result, however, tends to be a reintegration of tasks organised around expert systems. The example described by Hirschhorn is typical of many of the situations found in the financial sector:

> "At a Philadelphia insurance company, medical compensation clerks who typically processed claims now have a higher level of settlement (or dollar level) authority. In the past they could only settle small claims by themselves, because supervisors did not trust their judgement and capability. But now that they have instantaneous access to customer files, they have the data to survey the customer's entire financial record. They need not rely on 'long experience' to extrapolate from small pieces of data to the general picture. Nor do they have to negotiate with many other clerks and supervisors to get the necessary data. The data makes them more competent."

ENGINEERS AND DRAUGHTSMEN

The conceptualisation and design of new products have been revolutionised by computer-assisted design; at first restricted to special fields such as aeronautics and motor vehicle design, it has now spread quite rapidly in recent years. After the mechanical engineering and electronics industries, construction, cartography, footwear, furniture and wearing apparel have followed the trend. State-of-the-art systems provide three-dimensional visualisation and facilitate the conceptualising of complex shapes and machine assemblies (CAD). The more commonly used two-dimensional systems have been likened to an automated drawing-board.

The current tendency is towards the gradual integration of these systems with the programming of automated machine-tools (computer-assisted manufacturing and design -- CAD/CAM) and management functions. However, this tendency is slow in making itself felt. Design offices equipped with these systems still employ engineers (especially for initial design) and technical draughtsmen of varying skills.

Studies of CAD (6) fail to reveal any profound change in organisation but they do point to a separation of activities between:

a) Development of basic software, a task carried out by mixed teams of computer experts and engineers or technicians working in specialised programming firms or in a few large user corporations;

b) Development and customisation of this software for certain user firms for their own needs (carried out by the same type of mixed team);

c) Application by design office personnel.

Where the latter is concerned, division of labour varies, sometimes according to type of equipment (in designing electrical circuits, first-generation design systems were incapable of carrying out every operation and thus favoured job fragmentation), but more often according to the nature of the work: shape design, electrical diagrams, tooling or machine parts design (Merchiers, 1984).

Some authors think they have detected a tendency to "introduce Taylorist principles into the design office" (Missika et al., 1981), or to parcellise jobs after reorganisation along industrial lines with a view to recouping investment in costly equipment (as in word processing).

These findings, however, seem to be contradicted by more recent studies. For instance, any specialisation is due mainly to the extra skills acquired by the handful of technicians involved in computer programming. This is the level at which the division of labour is likely to be most pronounced. Conversely, technicians restricted to using the system must observe more rigid procedures.

One notable effect of transition to new technology is the elimination of a number of repetitive (correcting and altering drawings), ancillary (filing and copying), and bread-and-butter (working drawings) jobs. The result is general upskilling (Eksl, 1982), to some extent because the proportionate weight of executant jobs is reduced, but also because there is greater reliance on highly qualified engineers and technicians familiar with computer systems.

Lastly, stronger links seem to be growing up between the design office and both the shopfloor and management. Economic considerations (the need to reduce unit costs by improved factory procedures) are more responsible for this than technical change, but technical change makes it possible, since the same data can be directly used for different purposes (the drawing of a part directly utilisable for machining). This is an example of the integration referred to earlier. It remains to be seen whether these new technical possibilities will lead to closer co-ordination of functions or to increased centralisation in the offices where numerically controlled machine-tools are programmed (Merchiers, 1984). The seemingly imminent threat to the engineering department by direct manufacturing (Missika, 1981) does not appear to be materialising with the ease that was predicted.

SECRETARIES AND TYPISTS

In its broadest sense, the secretarial sector comprises a wide range of functions and occupational categories:

- -- Production of customer services, like large administrative offices, requires a volume of typing (correspondence, billing, etc.) that is often repetitive whether or not it is accompanied by other operations. The secretarial staff attached to other functions are fewer in number and their work is more varied.
- -- Three categories of employees at least are called upon to do typing: typists, secretaries on the services side (more like office workers in that their job is coloured by their service speciality), and management secretaries. For these latter two categories, typing is but one of a number of varied tasks (Mandon, 1982b).

Obviously, work organisation and the impact of new technology differ according to circumstances. Moreover, word processors have only recently been introduced (7) and they are still being perfected, so their full impact cannot yet be gauged. We may therefore agree with Murphree that "the concept of word processing as a monolithic phenomenon is an erroneous simplification".

Well before such technological innovation, attempts had been made, as with bank and insurance clerks, to restructure the secretarial units of large administrative bodies along industrial lines. This led to the creation not only of the typing pool but also of separate teams for the erstwhile secretarial functions of filing, proofreading and correspondence (Murphree n.d.).

With the introduction of word processing, new forms of work organisation are being tried in an attempt to recoup the high initial cost of the new equipment. To begin with, they have the appearance of restructuring which has not found its final form (Mandon, 1976), with the machines sometimes centralised in pools and sometimes available on a free-for-all basis, etc.

Experts differ, however, in the way they interpret these developments in work organisation. Some of them (Fossum in Scandinavia, Benoît and Cossette in Quebec, 1983) do not consider that word processing has wrought significant change.

Others (IAURIF, Informatisation et emploi, 1984) claim that "typing pools, which were once on the way out, are reappearing with the introduction of expensive office automation equipment. This is a setback for the nascent tendency towards versatility". Certain authors go so far as to predict the possible disappearance of the personal secretary.

Yet others draw a distinction between the potential for change and change itself. In the opinion of Pomfrett et al. in Great Britain (1984), forecasts that word processing would polarise work organisation into either integration or specialistion have not materialised. There has been no revolution so far, and frequently no change, but technology has created a potential for change. Change takes place slowly as technology and organisations gain experience. Buchanan (1982) also thinks that word processing can open up a field for skilled and efficient work but that an apposite strategy and form of organisation are needed in order to extract the most benefit from it. Mandon (1976) went one step further by saying that a discrepancy existed between the organisational logic of extreme job differentiation and the potential of flexible, versatile equipment.

Recent observations describe what may be the beginnings of a trend away from job differentiation and the pool concept (Coffey, 1982, in Australia; the MSC Research Bureau, 1982; and Buchanan, 1983b, in Great Britain). This trend is accentuated in today's most advanced firms by the movement towards integration and the development of technology that goes beyond simple word processing:

-- The possibility now available to secretarial departments to create new computerised files or automate filing systems formerly operated manually is leading to a fresh distribution of tasks between secretaries, typing pool, clerks and computer specialists;

-- Electronic mail;

-- Computer link-up in the foreseeable and perhaps very near future.

To sum up, "the distinction between word processing and numerical data processing, which was quite clear when the first word processors were introduced, is becoming more and more blurred. Many more specific applications combining figures, files, text, and even graphics are involving ever larger numbers of staff. There is a considerable effort to co-ordinate and integrate equipment that was previously introduced haphazardly" (CEREQ, 1983).

In keeping with this trend, the time-honoured occupational dividing-lines are changing. There are still pools but they provide new services. The secretary's role is undergoing transformation. In the secretarial and office automation field, completely new functions are emerging (training, job assistance, course leadership, co-ordination) (Mandon, 1985 forthcoming).

Again in line with the same trend, we might quote L. Hirschhorn's recent study (Office Automation, 1984c):

> "The typing pool was a transitional solution to the problem of integrating computers into office work. As long as the price of hardware and software remained high, it paid companies to purchase dedicated word processors and create a group of specialised typists who did nothing but input text. The high cost of the processors was justified by the economies of specialisation. But the declining cost of computer hardware and software is giving rise to the integrated work station in which operators manipulate words, pictures and data together to create, or "publish", documents of high visual quality. Moreover, as managers learn to do their own keyboarding, the office "operators" increasingly supervise a document production process, rather than operate within it. They monitor the office machinery while negotiating with and serving users.

Indeed it seems as if three para-professions may be emerging from the increasingly obsolete secretarial role: the para-publisher, the para-librarian and the para-manager. The first supervises the document production process, the second supervises file and index management, with particular reference to cross-referencing, and the third prepares budgets, monitors master-calendar preparation and maintains such control system data bases as productivity and time records."

PRODUCTION MANAGEMENT STAFF

Although less extensively investigated than the foregoing, this field is worth mentioning because of its close links with industrial production, the automation of which has, until recently, attracted the most attention.

Production management includes preparatory and follow-up work relating to the movement and transformation of products during manufacture. Depending on whether the product is simple or complex, whether or not there is mass production, the operations and their degree of automation vary enormously. The systems usually installed help with decision-making rather than ensure complete automation, and thus leave ample scope for human action (Conquet and Magnier, 1985).

Mass production management used to lend itself to repetitive, linear first-generation computer processing. It has followed the trend towards real time, conversational, more integrated systems that provide faster updating, more comprehensive data use, and better co-ordination of accounting, manufacturing and marketing, etc. While this development has not had any profound effect on organisational structure, it has brought about greater access on the part of sectors and individuals to a vaster network of information. It has also led to some limited changes in the skills pattern by eliminating menial jobs (those concerned with collecting information subsequently memorised by the system).

More significant changes occurred in the case of limited-series manufacture of a complex product (Mandon, Rannou, 1984). At the start, computerisation affected little more than book-keeping. During the 1970s, and above all in 1980, extensions gradually took in other aspects of management and production, as management of separate industrial operations became more decentralised and on-line teleprocessing became available. "Data entry and enquiry stations were spread among the different services in order to feed a common data base. The arrival of the conversational keyboard and screen broke down the barrier between the computer and user departments. The system no longer consists of an alignment of linear, unifunctional computer units. It takes the form of a network embracing the complete range of the establishment's information channels. It makes up a coherent whole integrating many kinds of application superimposed on the deconcentrated organisation chart" (Mandon, Rannou, 1984).

The term "decentralisation" cropped up again and again in the course of the authors' research, in its geographical, organisational and informational senses. However, they preferred to use the word "deconcentration" because, "while it was true that dispersion of the centres of initiative, responsibility and control had occurred, the strategic decision-making apparatus had been maintained, leading to a centralisation of planning and management control data".

The various situations described, although very different, have the idea of integration as their first point in common. Their second point in common is the strengthened role of the function (and the personnel related to this function) interconnecting the various classical activities of industry and those of the services sector. The effect of this change on skills will be examined subsequently.

CONCLUSION

The conclusions of the last two chapters on the restructuring of the tertiary sector and the reordering of the division of labour may be summed up as follows. Some authors continue to think that new technology accentuates Taylorist-style restructuring, characterised by deskilling (Muldur in Montmollin, 1984, for example). Some applications, such as the processing of bank cheques or credit card debit slips, tend to bear out this thesis.

In fact, this kind of application seems more and more to be the exception to the rule, illustrating the wide variety of situations and the difference between the old- and new-style use of technology. The movement appears to be towards a new division of labour different from, and even opposite to, the trends hitherto observed in tertiary work organisation. Verdier (1984) calls this, not neo-Taylorism, but post-Taylorism, whereas Appelbaum (1984) sees the phenomenon as a pure and simple rejection of Taylorism.

We share this view but would temper it by asking the following questions:

-- What will be the impact on skills?

-- What will be the effect on manpower supply and demand?

-- What factors are likely to accelerate or delay the new division of labour, and will the imbalance between investment in equipment and changes in work organisation be corrected?

Chapter 4

SKILLS AND JOB CONTENT

CHANGES IN OVERALL SKILL LEVELS

From the point of view of work, the foregoing discussion raises these questions:

-- What is the direction of change in skill requirements and employment structure?

-- What are the general trends affecting individual action (job content, knowledge and know-how), particularly as a result of new technology?

We cannot avoid mentioning the controversy over whether new technology contributes to a general raising of skill levels or whether it is a cause of deskilling or polarisation of skills.

The controversy is, however, defused by our initial postulate assigning only relative importance to the role of technology, capable as it is of serving a wide range of options and policies.

This being admitted, the foregoing study of its fields of application showed just how many situations can influence the division of labour and, consequently, the pattern of skills required.

The conclusion arrived at by P. Samson et al. (1983) seems justified: "There is no evidence that the present state of computerisation systematically contributes to either upskilling or deskilling the personnel involved" (see also A. d'Iribarne, 1983).

In our opinion, any tendency to deskilling over the past few decades was due much more to a restructuring of administrative operations begun before computerisation than to computerisation itself. While the earlier generation of computer equipment may have accentuated the tendency, the new generation of integrated systems ought in principle to favour the contrary trend. At least statistically, it is probably still too early to gauge its effects.

It is in any case necessary to define our terms:

- When referring to change, are the same situations and categories being compared? As Appelbaum (1984) remarks, "Deskilled in relation to what is the issue". Are we talking about clerks only or are we including middle-level supervisory staff? How do we deal with the central fact up to now, namely, the elimination of the least skilled jobs? Does this constitute upskilling?
- This leads us to make the distinction proposed by Arnold (1983) between the group and the individual viewpoint, that is to say, between the change in job distribution among categories and the purely qualitative change of job content within the same category.
- Lastly, what skills are we talking about? Do we refer to abilities, individual differences including qualifications, or salary brackets? And what are the abilities in question? "Research into the impacts of technology on skill will prove inconclusive unless the different dimensions of skill are considered" (Hirschhorn, 1984a).

According to the definition chosen and to whether firm, sector or country is being studied, the conclusions reached will differ greatly. It is therefore essential to refine the analysis, quantitatively first and then qualitatively.

EMPLOYMENT AND OCCUPATIONAL STRUCTURE

If we look at the broad occupational categories, certain trends seem indisputable and likely to continue:

- A drop, at first proportionate and then absolute, in the number of least skilled workers, i.e. those entrusted with repetitive routine tasks (filing of mail, data entry, copy typing). On the one hand, this is the result of technological change, with the increasing automation of these tasks. On the other hand, it may also result from a combination of firms acting in advance of change and the arrival on the labour market of better qualified young people, whose different job classification shows up in the statistics.
- Another trend concerns the calling into question of lower management. The qualitative effects of this are still hard to measure, but the discipline and clarity of computer-based procedures, allied with better management and new forms of organisation, seem bound to result in the elimination or transformation of a number of these posts.
- Conversely, there is a trend towards growth, both proportionately and in absolute terms, in the number of highly-skilled employees and technical supervisory staff.

Problems of source and method make it difficult to advance statistical proof of these suppositions without more thorough investigation. However, in Sweden, the Commission on the Effects of Computer Sciences (Arbetsmarknads-Departementet, 1984) estimated that, in the insurance industry, the proportion of routine jobs fell from 56 per cent in 1961 to 50 per cent in 1973 and 30 per cent in 1979, which would indicate recent acceleration of the process. Likewise, BLS estimates for the industry in the United States, quoted by Appelbaum (1984), confirm the drop in the proportion of non-qualified posts (filing, mailing, data entry, ledger work) in favour of technical and supervisory jobs.

The picture is less clear at national level. The latest BLS figures for the United States (8) show and project an increase in the relative weight of clerical workers, some categories of which have declined in relative (and occasionally in absolute) terms (data entry, book-keeping clerks). In France in recent years the level of unskilled white-collar workers has remained practically stationary while that of skilled employees continues to rise.

Also at national level, two additional trends may be noted:

- The need for new technology specialists is expected to increase, but with a shift towards software experts and away from electronics technicians;
- The dividing-line between software experts and *users* is tending to break down, with an increase in the weight of the latter. As the applications of ADP multiply, an ever-increasing number of jobs and functions are drawn in. The experts no longer have a monopoly of knowledge and a growing number of users acquire their skills. One consequence is that "the competition between specialists and non-specialists may become keener, and the identity and status of the computer expert questioned" (Cossalter and Denis, 1982). Another is that, while the number of specialists continues to rise, that of the users is rising even faster, although problems of method and terminology make it difficult to calculate the exact figures (Bertrand and Naymark, 1984).

Is it possible to go further and speak of *whole job categories* disappearing? We are not prepared to go as far as the Swedish Commission in thinking that the occupations of secretary, typist, telephone operator, post office worker, bank or insurance clerk, and computer clerk are threatened. At most (unless over a very long term) a relative drop might occur, and even this is scarcely borne out (except for postal workers) by the BLS forecasts.

It is, moreover, worth stressing that the very notion of occupation and especially the separation between occupations is tending to disappear (Hayes, 1980). This is particularly the case with the new technologies. When taken together with the new modes of organisation, they tend to designate activities without any clear or stable profile. This observation leads us to doubt, along with Grünewald and Koch (1981), that entirely novel occupations will appear. We prefer to predict that existing jobs will evolve either in the direction of specialisation or, on the contrary, of increased versatility.

In the technical field, specialities, notably data processing and telecommunications, are combining together to create posts such as "telematics manager", "teleprocessing technician" or, at a higher level, "information systems manager". Computer security is yet another example of specialisation.

From the point of view of this study, perhaps the most meaningful and important transformation is the rise of the new job of group organiser/trainer (Mandon, 1982b; Coffey, 1982) and, especially, of twin-skilled jobs dealing with the interface between data processing services and users: data processing correspondent, systems administrator, or users' representative.

TRANSFORMATION OF JOB CHARACTERISTICS AND CONTENT

It may seem difficult, after the emphasis laid on the variety of job situations and the impact on skills of organisational choice, to speak in general terms about trends in job character. Some authors (Metzner and Rohde, 1983, for example) refuse to do so. By concentrating on office workers, however, and leaving out the differences due to the aforementioned modes of division of labour, it may be possible to identify certain dominant trends. This may be done by examining such job features as content, responsibility, independence, knowledge, know-how and required behavioural characteristics. [For other ways of classifying these features, see Dirrheimer (1983), Grünewald and Koch (1981) and Hirschhorn (1984a)].

THE CONTENT OF INDIVIDUAL ACTIVITY

This content may be defined according to a number of criteria, such as range of skills, job complexity and repetitiveness, hierarchical and functional relation between the jobholder and equipment, documents and persons.

The only general change to be considered is that all the jobs affected by new information technology involve working with a conversational keyboard and display screen. This may be put to such a variety of uses that it is insufficient to describe a job (Metzner and Rohde, 1983). Use of this equipment is, however, the outward sign of a much deeper change, notably signifying "the mediatisation by sets of information of the relationship with the object to be processed ... and another mode of acting on the object, which becomes a complex system" (Cossalter and Denis, 1982). In particular, the opportunity to enter and consult data without time lag or the use of paper, to access data banks, etc., should be noted.

Increased abstraction is a second feature of work connected with ADP. Since both data and programmes are stored in the computer's memory, less paper documents are used and other mental processes and operations are called into play. The work is "intellectualised" (Genstor, CEDEFOP, 1984).

The trend concerning simple, repetitive tasks (collating, copying, data entry and logging, simple calculation) is somewhat more complex. Obviously, automation can cut down their overall volume. There was a tendency in the early stages to assign the remaining operations to certain categories of personnel (punch-card girls, for example). The new generation of office equipment has made it possible to undo this kind of specialisation and also to automate other operations (Automatic Teller Machines, repetitive typing). Some firms also try to avoid over-concentration of repetitive tasks in order to prevent worker frustration. The overall volume of simple, repetitive tasks continues to fall, but they are shared out differently, so that some categories have more higher-level tasks to perform, while others are in the opposite situation, depending on the type of activity and organisational choice (Metzner and Rohde, 1983; Benoît and Cossette, 1983; Grünewald and Koch, 1981). In most cases, provided that workers and their supervisory staff seize the opportunity, a gradual emancipation from repetitive tasks should occur, leading to more rewarding, varied and interesting tasks of a technical or interpersonal nature (Coffey, 1982).

To what extent have computer tasks themselves expanded? While computer use is less and less the exclusive preserve of a centralised service, programming remains largely a field for specialists, even more so now that inexpensive software packages adapted to most purposes are widely available. A handful only of technicians and middle-level staff are required to do programming, for special applications (technical work, as with CAD, or budget calculations, for example). Some firms consider that programming is a poor way for their middle-level personnel to spend their time and prefer to leave programme development and follow-up to the data processing service.

The need to keep services running flexibly, efficiently and continuously leads to interchangeability among personnel. Moreover, the growing degree of integration brought about by the new technology implies that a given operation affects a number of functions: production, management, technical, administrative. There is thus a tendency for the functions (or field of action) of tertiary personnel to expand, all the more so since they are spared from carrying out routine or specialised tasks. This expansion is naturally correlated with the degree of integration.

Concurrently, the relational field often -- although not always (9) -- expands, and the idea of team effort takes on increasing importance. This is yet another logical consequence of technical development and changing modes of organisation, responding to economic necessity. In the banking/insurance sector, for instance, the time made available by the automation of simple clerical operations can be devoted to developing customer relations. The desire to motivate staff and give them a sense of responsibility leads many firms to revise hierarchical attitudes. Meanwhile, the need to promote interchangeability leads to an enlargement of the relational fabric, just as expanded functions create an expanded network of contacts. However, these contacts are not necessarily material in nature. As in industry, an increase in interpersonal relations (through telematics) can coexist with accentuated physical isolation.

ADDED RESPONSIBILITY

As in industry, the trend may be said to favour increased responsibility, due simultaneously to: the increased scale of computerised systems, the spread of on-line data keying and, especially, integration. Any errors that occur produce wider repercussions on a variety of functions and may affect the whole system, especially as there no longer exists an intermediate step at which operations are checked before the results are transmitted. It has been stated that the type of error has changed, becoming more "human" and thus harder to forestall and detect (Hirschhorn, 1984a; Adler, 1983).

This, plus the particularities of the interactive mode, adds to the demanding nature of computer work in general and to the nervous tension it induces (Shaiken, in Gregory and Marshall (eds.), Office Automation, 1983; Coffey, 1982; Hirschhorn, 1984a).

LIMITED INDEPENDENCE

A number of authors point out that the formalisation and predetermined character of computerised systems act as a constraint which inevitably limits the user's independence. A large number of decisions are taken at the programme conception stage, so that the only room left for personal initiative concerns unforeseen circumstances (Grünewald and Koch, 1981; Zimbalist, 1979). However, this depends a great deal on modes of organisation, and it is difficult to generalise.

Perhaps more serious is that the new systems' transparency and information processing capacity lend themselves to a much stricter control of personnel output and its results. In the United States, for example, "management has found that, with word processing, it can for the first time monitor the productivity of secretariat workers and gain some degree of control over this function" (Shaiken, in Office Automation; see also Les Puces , 1982). What is more, skilled and senior personnel who had hitherto enjoyed considerable independence can also now be monitored (Hirschhorn, 1984a). Whether or not this possibility is used depends very much on social and cultural contexts and on employee and trade union resistance. However, there is no doubting that the potential exists.

Conversely, at least where the more technical applications (CAD) are concerned, automation of routine tasks is seen by some as a factor which frees the imagination, creativity and spirit of initiative of users. Certain authors believe that for office work this is the trend of the future.

The possible curbs on independence are not incompatible with upskilling and specialisation (Grünewald and Koch, 1981; Appelbaum, 1984). That is to say that different aspects of a skill can change in opposite directions. What is modified is the general composition of the skill.

KNOWLEDGE, KNOW-HOW, ABILITIES, BEHAVIOUR

Change can be followed by using the two distinctions suggested by Barcet et al., (1984). Although intended for examining industrial conditions, they may be usefully applied to the tertiary sector:

-- Distinction between empirical know-how "derived from the practical relationship between a worker and the object or instruments of his work", and analytical know-how requiring a "prior or supplementary scientific side-approach, an intellectual grasp";

-- Distinction between partial know-how concerned with a stage or portion of the work process, and broad overall know-how.

a) The disappearance of certain types of empirical know-how

For instance, among these are typing speed (since it is now more the machine than the typist that determines this) (10), neatness in typing or draughtsmanship, mental arithmetic. Shorthand, for its part, seems to be being replaced by dictaphones or tape recorders.

To take an example from the insurance industry, automated systems have long processed current risks, so that the skill of the better-qualified workers consists in being able to decide special cases by consulting the basic rate. However, with increased computerisation and the versatility of the latest systems, even special cases can be taken care of. This reduces the role of certain categories of skilled personnel, and particularly the bottom tier of supervisory staff.

Here we may recall the Swedish Commission's observation that skills are concentrated in data processing systems controlled by a handful of specialists. As a result, there is a risk -- as in the industrial sector (d'Iribarne, 1985) -- that traditional skills may disappear. For example, insurance premium calculation factors are now stored in computer memories and employees no longer receive training in the principles underlying the calculations. In emergency situations or if an error has to be corrected, problems arise.

While many kinds of empirical know-how are being lost, others are being invented (memorisation of codes, for example, and dexterity at using the more complex keyboards of word processors). In general, however, the new types of know-how, such as file-handling and procedural expertise, tend to be progressively more analytical.

Like industrial automation, data processing systems integrate at least a part of employee know-how. But the know-how of some technicians can actually be shown off to advantage when they are required to invent or adapt a programme. The process in any case has its limits: "The system (CAD) integrates the project designers' professional experience, but not totally, to the extent that certain variables and ideas can be neither formalised nor modelised" (Merchiers, 1984).

This coincides with an observation made in connection with industrial automation, namely, that the main role of automated systems operators is now to solve problems rather than carry out productive tasks. As is shown in banking (Rajan, 1984), "Under emerging practices, increasing emphasis is put on diagnostic skills".

This remark must not be overgeneralised and it does not apply to such work as "typing" on a word processor. Another remark which is more generally valid stipulates that, as the responsibility of operators grows, "it is important to recognise the sensitive areas in which they must absolutely avoid committing errors" (Mandon and Rannou, 1984).

b) Extended areas of competence and broader knowledge

The essential requirement for users would often seem to be a better ability to grasp their particular place in a technical/organisational environment. This may be understood in several senses.

First of all, working with computerised systems presupposes knowledge of the information network in which the entered, processed or used data has its place. When computer skills are necessary, they are usually required in this area.

Usually this knowledge, as a consequence of information system integration, implies an understanding of the various functions and activities of the enterprise. (This brings us back to the distinction between broad and partial know-how). In production management, for example, each employee should have in mind the various applications of the data that he is processing and therefore possess an understanding of the activity of each service liable to use the data. In the case of CAD, designers of new products must pay greater attention to manufacturing conditions, for technical reasons (the design may be used directly in the machining programme) and with an eye to good management (manufacture should cost as little as possible).

In general, more importance needs to be given to the idea of management, starting with the management of one's own work (as, for example, the management of the information stored on a diskette), to increased involvement of more and more people in the overall management principles of the enterprise.

A broader field of action can thus be seen to lead to a broader field of skills, some of which are specific (knowledge of information circuits, phases of production, the services in an enterprise) and others more general (accountancy, administration, management).

c) Current change and abilities, attitudes and behaviour.

The enquiry by Mandon and Rannou in Quebec (1983) gives emphasis to the attitudes of middle management staff and especially their ability to assess their own needs. This ability depends on a capacity for criticism and suggestion aimed at getting the best out of the system and improving it.

There is a convergence here with the suppleness of the new computer technology in response to the need for marketing adaptability and better management. This flexibility of the computer systems parallels the suppleness required of staff as a response to continual change.

In addition to these abilities, employers usually ask that systems staff possess "a logical mind", whereas the foregoing analysis makes it clear that a talent for increasingly abstract thought is also needed.

There is reason to believe that the growing integration of computer systems with telecommunications, because of the possibility it offers of contact with distant interlocutors and receiving back instant information and reactions, will alter employees' perception of space and time (Cossalter and Denis, 1982).

Lastly, it may be supposed that, in the tertiary as in the industrial sector, added responsibilities and the growing involvement of all personnel in improving management will entail increasing identification with corporate goals and the company spirit. Such a change will have an impact on a firm's recruitment profiles and personnel management policies.

CONCLUSION

In concluding this chapter, three main points are worth re-emphasizing. The first concerns skills in the narrow sense: the arrival of the new generation of data processing systems does not necessarily lead to deskilling; it produces rather a multidimensional change in which such factors as job scope, complexity, repetitiveness and the relationship between jobholder and equipment, documents or persons may change, for better or for worse. The second point is that, since the new technology tends to be concerned with solving production problems, it shifts job scope and skills towards diagnosis, problem solving, the interface between systems and, of course, customer contact. The third point is that, insofar as the new systems automate more and more complex ("expert") production operations, they threaten the position of some of the former possessors of this expertise, namely, the better-skilled employees and junior management and supervisory staff.

Chapter 5

THE CONSEQUENCES ON MANPOWER

SALARY SCALES AND JOB STATUS

Few studies appear to have been devoted to this aspect of the current changes, whose context differs greatly according to country. It raises the whole question of skill definition and its recognition in social and institutional terms. At first glance, the new technology does not seem to have brought about any important, or at least automatic, changes in salary scales. Some employers insist that using a computer does not alter a person's skills (for salary purposes) except, possibly indirectly, by enabling him to improve his performance. According to some trade unions, less-skilled workers now accomplish tasks which used to require specialist knowledge, without any change in their job status (International Federation of Commercial, Clerical and Technical Employees, 1979).

Operating new equipment can create a more or less prestigious image among the staff concerned. In word processing, for example, "jobs have taken on further prestige, through the glamour of being associated with the latest generation of office technology", whereas management secretaries tend to despise typing and leave it to the machine operators (Coffey, 1982). In the opinion of Gaussin et al. (1984), "Social esteem attaches to computer-linked occupations ... but it wears off in time ... Growing familiarity with the new techniques takes the mystery out of the jobs pertaining to them."

MORE STRINGENT HIRING STANDARDS

In the tertiary sector as in industry, the general trend is for firms to demand higher professional qualification (European Centre for the Development of Vocational Training, 1984).

There are several possible reasons for this:

-- The transformation of job content discussed earlier, i.e., greater emphasis on logical ability, increased range of skills, higher degree of abstraction, implies higher educational qualifications;

- Better education can be thought of as guaranteeing career adaptability. Partly because the career profile for the new jobs is still vague, partly with a view to future developments, firms endeavour to build up their skill potential (Baethge, quoted by Dirrheimer, 1983);

- The demand for higher qualifications is made easier by the general rise in educational levels observed in most countries.

It is hard to tell which of these factors weighs most and whether the rise is due to a real need generated by job transformations and the impact of new technology or whether it reflects the state of the labour market. In the United States and some other OECD countries, the weight of secondary and university qualifications would seem to be on the increase.

> The tendencies towards a loosening of internal linkages among major clusters of occupations in large firms place an increased emphasis on the role which other and especially educational institutions play in the process of upward mobility" (Noyelle, 1984 -- for discussion of mobility, see below).

Insurance companies, for instance, now recruit from university (and not secondary school) graduates, not because of the special skills imparted but because the universities ensure a certain basic level of general education and problem-solving ability (Appelbaum, 1984).

Similarly, in Great Britain, the general educational level of secretaries is rising, at the same time as firms are becoming less demanding concerning their secretarial training (Silverstone and Towler, 1983).

Educational criteria are not the only elements which decide selection for the new jobs. Age is often essential, since older employees are thought to have more trouble in adapting to new technology.

CHANGE OF WORKPLACE

Changes in company policy, particularly in the United States, are affecting the localisation and nature of manpower. Many of the major financial institutions have transferred their offices out of the large cities and into the suburban areas or medium-sized towns, where the population is mainly white (Appelbaum, 1984; Noyelle, 1984). In a number of other countries, such as France, there has been a movement to "deconcentrate" large administrative units away from Paris and its surrounding area (IFCCTE, 1979).

DISRUPTED CAREER STRUCTURES

Many studies consider that the current changes induced by technology alter career prospects. In the United States, particularly in the finance sector, "recently won avenues of upward mobility from skilled clerical to lower level professional jobs and then, for some, to skilled professional or management positions have been curtailed by the automation of less skilled professional functions" (Appelbaum, 1984). "There is a danger inherent in the current system that even in large companies, workers will be, more or less, permanently locked into a limited cluster of occupations (determined on the basis of earlier education) from the start of their employment" (Noyelle, 1983). If we refer to the theories of labour market segmentation, "this means that entry into large firms does not necessarily give access or even prospect for access to primary sector type of employment" (ibid.).

In Great Britain, also in the finance sector, the gap has widened between "career" and "non-career" (general employee) streams. "Career entrants and professional staff will possess broadly-based qualifications and analytical skills, of the sort new technologies are already demanding elsewhere" (Rajan, 1984). Oberbeck (1983), and Verdier (in Montmollin, 1984) observe as a fact or a risk the disruption of traditional career ladders and the increased compartmentalisation of occupational categories and their career prospects. In Oberbeck's view, women are particularly affected, since they are at a disadvantage when it comes to taking the recurrent education courses upon which promotion largely depends.

Most observers are also pessimistic about the prospects for secretarial staff. In their case, the cause lies less in the disruption of existing career ladders than in the non-existence of new ones. Typists aspire to become secretaries. With the introduction of office automation, they hope to enter a new career stream, but there is a risk that the new technology will become commonplace. Until now, there has been no evidence of desirable future prospects [in France, according to Mélèze in IAURIF, Informatisation et emploi (Computerisation and Employment), 1984].

Still in Great Britain, "previously, a shorthand-typist had the possibility of promotion to secretary. Word processor operators are unlikely to progress beyond word processor supervisor, because that is the top of the career ladder, unless the company has a policy of promoting from operator into a different activity" (Tarbuck, in Social Change, EEC, 1983).

More specifically, everything depends on individual company policy. In France, Mandon and Rannou (work in progress) have noted new career prospects among the most advanced firms in the areas of training, diffusion and experimentation of open-ended technology, i.e. on the more technical side of management.

Career structures seem also to be changing in CAD. Staff who reach a certain level of competence with computers find other avenues of advancement open to them. On the other hand, because low-level recruitment has dried up, promotion prospects are limited (Arnold and Senker, 1983).

The problem created by higher recruitment standards and limited career mobility has much broader repercussions in fact. In Japan, it is mentioned as concerning all white-collar workers (Japan Economic Journal, 3rd May 1983).

LAY-OFFS, READAPTATION, REASSIGNMENT

The combined effects of employment level as affected by the changes under way and of corporate recruitment and personnel management policies vary greatly according to enterprise and country. In the worst cases, the firm lays off superfluous staff; at best, it reduces the workforce by not replacing workers who leave in the normal course of events, or by training and transferring staff to its expanding sectors.

Is there reason to fear the same problems of massive restructuring in the tertiary sector as arose in traditional industry in many countries? The answers are contradictory. For one thing, the better educational background of clerical workers as compared with most blue-collar workers should make redeployment easier for them. They are less easy to classify in terms of traditional or specialised callings. Other authors, however (Pape, in Fossum, 1983), believe that office workers, more than industrial workers, learn skills on the job which are limited to their particular firm and are thus inapplicable and of little value to other firms. Tertiary jobs, more than jobs in industry, may belong to a more closed internal labour market.

While interesting, this thesis is hard to prove statistically, since intercorporate mobility depends on a wealth of variables. In any case, past experience is probably no guide to the future. So far, clerical employment levels have fluctuated less than in industry, partly because they have been rising continuously and partly because, at least in practice, office jobs are "safe". This situation, however, is beginning to change in a number of OECD countries. Again, white-collar workers had more trouble adapting to new jobs with the old skills founded on empirical experience than they have with the new, more general and abstract, skills. It also is reasonable to think that, since similar new technology is used in many different sectors, transfer from one to the the other is easier (Noyelle, 1984).

The lower the level of basic education, the greater are the difficulties experienced in adapting. And the problem is different for the various social groups.

DIFFERENT MANPOWER GROUPS ARE AFFECTED IN DIFFERENT WAYS

Certain workforce groups are more vulnerable to change than others: women (because they occupy the majority of clerical positions), elderly employees and the less-educated young, especially those belonging to ethnic minorities and/or living in large cities. According to G. Schwartz (1984), in the United States, "there is a very real danger that some groups will be completely left out of the technologically-oriented economy. In particular, the schism between urban black/hispanic job-have-nots and suburban, white and oriental job-haves can grow wider." "Sex-race labeling continues to prevail in both the smallest occupational cluster, that of line management, and most importantly in the two largest occupational clusters, those of low and medium skilled jobs" (Noyelle, 1983b). Appelbaum (1984) sees the same thing happening in the insurance industry, where female segregation, after having been successfully combated, is returning in a subtle way because of the widening gulf between the level of education of women already employed and the very high educational qualifications being asked of new job applicants.

The trade unions often also point out the risks posed by part-time and at-home work that may become more common as a result of new technology (Gregory and Marshall, 1983). The problem is perceptible in Europe also. In Germany, for example, women are felt to be more vulnerable than men to the changes taking place (Oberbeck, 1983).

In Japan, a poll of 568 enterprises revealed that the female component of the workforce was declining while the male component was rising, proof that the former was harder hit by computer-linked restructuring (Japan Labor Bulletin, 1st November 1982).

The problems confronting the various categories are obviously not the same. There is a dwindling supply of job openings for the unskilled young; women are threatened by an absence of job and promotion prospects; older workers have difficulties with regard to job adaptation and transfer. In the latter, the sources of their difficulties seem to be (Weimer, 1982):

-- The more abstract nature of automated systems work;

-- Their generally lower educational level and an education which did not prepare them for this kind of work;

-- The fact that their experience and detailed knowledge count for less in the new context;

-- Automation-related changes in work content and organisation to which they have difficulty in adapting;

-- Limited prospects of promotion, especially for the oldest among them;

CONCLUSION

While job and salary classifications may not often be openly and directly disputed, studies show that the many changes accompanying the diffusion of the new technology usually bring about a tacit modification of job status. These qualitative changes, as well as the risk -- even occasional -- of jobs being displaced, focus attention once again on the manner in which the new technology is introduced.

The reader may sense a contradiction between the "optimism" of the previous chapter (on job content and skills) and the more "pessimistic" tone of the present chapter (on the effects on manpower). It is an apparent contradiction only. We are above all witnessing the transition from an old state of equilibrium between jobs and manpower to a new equilibrium in which the requirements are tougher. During the transition phase, a section of the workforce will encounter problems of adaptation and this situation has to be carefully analysed and acted upon.

Chapter 6

EXPLANATORY FACTORS

The earlier chapters emphasized the wide variety of circumstances, both as to the speed of dissemination of new technology and work patterns and as to modes of organisation and their impact on skills. This diversity should temper any desire to generalise. However, if we are to reach a better understanding of the nature and scope of the processes currently at work, we must not stop there. It is important to try to identify the explanatory factors.

The factors to be considered may be grouped as follows: economic factors (sector, product, scale); time factors; social and institutional factors (national contexts, managerial policies).

ECONOMIC FACTORS AND BRANCH OF ACTIVITY

The rate at which technology spreads and its impact seem determined by its relation with the production sector as a whole, by the branch of activity, by the type of product it creates (intrafirm or client service) and by company size.

A preliminary synthesis of existing studies seems to show that:

-- Banking and insurance lead the way in use of new technology and new forms of work organisation.

-- The dissemination pattern from one branch to another is roughly the same in all countries. After finance come transport, wholesaling, telecommunications, and public utilities in rapid order. Retailing and other consumer services follow. Lastly, we find the civil service, health and education. There are exceptions to the sequence, such as government revenue services which were automated at an early stage. As they have much in common with banking and insurance, this is no surprise, and they remind us of the product factor treated further down. But what are the reasons behind this sequence?

It may be worth restating the basic assumption of this study, namely, that the growth in services reflects a qualitative mutation of society, in which the sectors successively reposition themselves with respect to the overall economy and act as moving forces rather than as passive blocs.

According to the scenario outlined in the Introduction, the role of the "intermediate" services -- banking, insurance, transport, wholesale distribution, etc. -- evolves the fastest because of their close association with industry. The resulting impetus is intensified by growing competition on an increasingly international scale. The competition itself is often fanned with a view to hastening change (this is the philosophy underlying "deregulation").

Since competition affects the banking sector in varying degrees according to country, certain differences noted between countries might be explained by this. In the view of Senker (1984), the technological level of English banks is inferior to their place on the market, but it could be stepped up if they were exposed to genuine competition, from American banks in particular. It would be equally interesting to examine the situation of Japanese banks, which until now have been sheltered from international competition.

Lack of competition or external pressure may also partly explain the technological lag often (but not always) encountered in government and para-public services.

This thesis is all the more plausible given that budget restraints often seem to prod public services to change. In the United States, for example, the financial crisis of the big cities at the end of the 1970s triggered a veritable take-off in the computerisation of municipal services. Similarly, through the indirect stimulus of cuts in Medicare aid for retirees in the early 1980s, the Federal Government seems to have powerfully incited the American hospital sector to use modern technology.

NATURE OF PRODUCT

Along with the increasing role of services in the economy as a whole and the acceleration of change according to the competitive situation, the type of "product" and the functions underlying its production play an important part in both rate of diffusion and choice of organisation.

In industry, the nature of the manufactured product, its complexity and the degree of repetitiveness of the production process largely determine work organisation and the type of skills required. These factors are less prominent in the tertiary sector, probably because the notions of "product" and "production" are vaguer and less commonly accepted. A few examples will suffice to show that they are nevertheless valid:

-- Where clerical and secretarial work are concerned (see Mélèse in IAURIF, Informatisation et emploi, 1984), mass production of a document or

> result seems directly related to early automation, but also to a downskilling organisational mode. On the other hand, automation of repetitive tasks tends over a longer term to reduce the distance separating mass and non-repetitive production.

From this point of view, the novel distinction established by L. Hirschhorn (1984b) between evolutive and non-evolutive tertiary products is especially interesting. The distinction coincides to some extent with the provision of external services and the performance of in-house administrative operations. As Hirschhorn sees it, the evolutive nature of markets and products calls for a "developmental" scenario in which job specifications change, organisation is more flexible, independence is greater and skills rise. In the opposite case, technology tends to rationalise existing tasks, while organisation and supervision become stricter. This would seem to be often the case with word processing. Oberbeck (1983) partly confirms this analysis when he draws the distinction between new technology aimed only at automation and technology aimed at the market and its development, each leading to different patterns of organisation. Other examples can be found of differences due to the product: there are greater differences in the organisation of design offices concerned with machinery than in those dealing with electronics.

COMPANY SIZE

The size factor of an enterprise seems to have a bearing especially on the diffusion of new technology and on personnel skills. Generally speaking, small firms are less well equipped than large firms, partly for economic reasons (investment costs, break-even point linked to size) and partly because their management, often less well informed and trained, tend to be cautious. As prices come down and microcomputers and cheap package software become widely available, the cost factor should disappear, but the other problems remain and with them the question of training.

In general, small and medium-sized enterprises are, with a few exceptions, less advanced than large firms, irrespective of activity. On the other hand, they have the advantage of being less inert and can thereby catch up rapidly -- and even gain an advantage over larger enterprises. As far as work and skills are concerned, specialisation is usually less developed in the smaller firms. This is due partly to the fact that "horizontal" specialisation rises with the number of operators and partly to the fact that functional technicians in charge of special tasks exist mainly in large enterprises (Child, 1984c).

THE TIME FACTOR

Studies of work and skill transformation do not always relate their observations clearly enough with respect to when the innovations take place. It should therefore be stressed that:

- -- The price and performance of technology evolve rapidly. In the space of a few years, this can make a big difference to the conditions in which it is employed. As we have seen, the high cost of word processing in its early phase led to a type of pool organisation which later ceased to be justifiable.

- -- The experimental application of new technology for any particular purpose in an enterprise often does not entail any rethinking of the existing organisation, and should be distinguished from a later phase in which this rethinking may become necessary.

Great caution is therefore needed when extrapolating trends seemingly discernible in an isolated observation, especially if this observation deals with the experimental phase. We may recall Zisman's essay (1978) in which he described the then-current theory that mechanisation induced fragmentation whereas automation enabled integration of the fragmented tasks. Back in 1978, he did not feel that this theory had been fully confirmed, but he referred to another view according to which only the foundations of theory had been laid and confirmation of it was a matter for the future (11). This corresponds with our own view and we refer to it to explain the many negative findings concerning work organisation up to 1980.

This being said, we do not underestimate the factors of organisational inertia which tend to survive for some time after their causal context has disappeared.

SOCIO-INSTITUTIONAL FACTORS

The key assumption underlying this heading is that socio-institutional factors, especially the institutionalisation of relations between employers and employees in each country and corporate policy (itself to some extent determined by national conditions), are decisive where the rate of technology diffusion, organisational choice and modes of manpower management are concerned.

a) National context

The research of Maurice et al. (1982) underscored the importance of social factors in explaining differences in organisation and skill structures between countries. It showed that, in Germany and France, hierarchical structures could reflect differences in the skill patterns resulting from the respective training systems. As work in this field has so far dealt mainly with industry (12), we can do no more than pose some questions and hypotheses concerning the tertiary sector.

A basic postulate is that national particularities exist and that they result from the interaction of the following crucial factors:

- Education and training systems;
- Legal and regulatory institutional factors;
- Labour relations;
- Social and cultural context;
- Economic context.

The variety of education and training systems, and of labour force qualifications, in OECD countries is well known. But does this variety affect tertiary work organisation in the same way as it affects industry? We are not convinced that it does. For one thing, vocational training is less precise: white-collar workers are recruited largely on the basis of general education. Another hypothesis is that national traditions and culture appear to weigh less heavily in the tertiary sector than in industry. At this stage however these are only hypotheses derived from the research being analysed and they need to be tested empirically.

The legal and regulatory factors include:

- Legislation dealing with equipment and especially the conditions surrounding its introduction, including employer-employee negotiations. This type of legislation is highly comprehensive in the Scandinavian countries (Schneider, 1982), but practically non-existent in the United States. Such legislation can have an effect on both the rate of diffusion of technology and its impact on skills.

- The status and regulation of enterprise practices is an important factor. The two-stage nationalisation of French banks and large insurance companies may have had an influence on their employment policies. The different legal status of these companies and their commercial agency network affected the diffusion of new technology and organisation. In the United States, deregulation of these branches helped bring about a rapid transformation of products and structures, with important side-effects on organisation and employment.

- The degree of government intervention is another factor. In the telecommunications field for instance this has led to differences between countries that are otherwise comparable technologically.

The part played by the system of labour relations -- the degree of unionisation, the way the system functions, its role in determining skills -- merits further study. Unionisation and organisation among clerical workers in the United States, unlike other countries, is weak. The reverse is true in Scandinavia and Germany, where the unions are powerful and a long tradition of collective bargaining has produced a series of contract agreements. In Great Britain and the United States, at least in industry, union agreements have more or less institutionalised the skills associated with particular occupations or job situations and have thus contributed to specialisation. To a lesser degree this also holds true in France, although worker resistance to work organisation may well have influenced the way it has evolved.

Issues related to the socio-cultural context include:

- The composition of the workforce and ethnic minorities. Existence of the latter, especially in the United States, tends to accentuate labour market compartmentalisation (minorities in Europe are usually restricted to industry and a few service jobs);
- The degree of variation in mobility, both occupational and geographic, and fluctuating employment levels also explains the rate of change;
- Traditions emphasizing authority or hierarchy, as opposed to participation and more democratic decision-making are also important factors.

The structure of national economies refers us back, at least in part, to branches of activity and the size of enterprises. A given sector -- such as banking and insurance -- may be fairly uniform from one country to another, whereas the national economies, because of structural differences, may differ considerably. Any lag in computerisation in Italy, for example, is probably traceable to the fact that the economy is largely composed of very small firms, quite often in old-established sectors. Yet the situation of the Italian banking industry is doubtless not very different from that in other OECD countries.

b) Corporate policies

In addition to the factors outlined above, there are differences in work organisation and management strategies between individual enterprises, and these differences can be thrown into relief by the application of new technology. J. Child (1984a) sees four managerial strategies deriving from the new technology: practical elimination of "direct" labour; externalisation; polyvalence; deskilling.

Judging from changes taking place in industry, one wonders whether a distinction should not be made between different corporate strategies. In the United States and Europe, taking after the Japanese model, the more dynamic firms seem increasingly aware of the need to motivate their employees, by improving the quality of working-life in particular, which should involve making jobs more independent and interesting, and therefore more skilled. Many engineering supervisors, however, cling to a "scientific" conception of work organisation mistrustful of workers. They tend to consider automation as an end in itself. As one of them said, "If you get rid of everybody, you've got an ideal factory and most of your problems will be solved" (Child, 1984a). The relative predominance of one or another of these strategies may well explain organisational options.

Is the same pattern valid for tertiary sector activities? A precise answer to the question would require a more thorough investigation of how automated systems and decision-making structures are built up, as well as a comparison of the respective roles of computer experts and engineers. Nevertheless, a parallel between services and industry would seem to exist.

Although the tertiary sector appears to be less concerned than industry in applying different programmes of quality of working life, the degree of decentralisation both at decision-making and the introduction of computerisation, seems to be more developed in comparison with industry and this might have an important impact on work organisation and skills in the tertiary sector.

As to the matter of diffusion, the major American financial businesses that have been able to decentralise their operations appear to have achieved a higher degree of using technology and new work organisation than more centralised corporations (Noyelle, forthcoming).

Where work organisation is concerned, Child states that: "The labour elimination strategy can also be found in some parts of the service sector, where it simply manifests the logical conclusion of a widespread trend to shift the labour costs of service provision on to the customer (self-service in retail trade)." Our own conclusions support the idea that polyvalence is developing, with a subsequent weakening of occupational barriers. Deskilling, on the other hand, does not seem to be a systematic policy option; it is rather a side-effect of Taylorism. But is Taylorism as widespread and deeply entrenched in the service sector as it is in industry?

CONCLUSIONS

Do these considerations, taken together, allow us to draw any general conclusions about the comparative situation in the OECD countries? At this stage, such conclusions must necessarily be very impressionistic. Some points, however, can be made:

As far as the rate of diffusion of new technology is concerned, the foregoing observations and the findings of a number of studies reveal a contrast between:

- Findings concerning the changes observed in the United States and the predictions that they will accelerate. In the banking industry, for instance, says J. Leveson (1982), "while enormous changes have taken place in the last several years, the greatest changes are yet to come"; and
- The insistence of most European authors that the pace of change, notably organisational change, is and will continue to be slow, "in any event, much slower than the manufacturers' publicity likes to pretend" (Verdier, in Montmollin and Pastré, 1984, confirming the opinion of most Scandinavian writers on the subject).

On the question of work organisation, it is fairly certain that the rationalisation of office work has proceeded further and faster in America (including Canada -- Mandon and Rannou, 1983) than in Europe, and in France more perhaps than in Germany. In its early stages, computerisation in Europe of office work may have been more thwarted by institutional and socio-cultural obstacles than in the United States.

In general, American-style mobility would appear to make it easier to change direction faster than elsewhere and to strike a new balance between the development of human resources and the use of technology. Perhaps, in their own way, the Scandinavian countries have come close to striking this balance, which other European countries, because of their social and institutional rigidities, find it harder to achieve. It should be remembered, however, that there can be a human price to pay for mobility, and this is the reason why the circumstances in which change takes place should be discussed.

Chapter 7

GENERAL CONCLUSIONS

In the light of the preceding analysis, three kinds of questions have to be posed, namely:

- -- Given the situation of current change, and the options for actions that it provides, how can technology be better applied?
- -- What conclusions can be drawn as regards training and education?
- -- What is still needed in terms of further research?

The search for a better use of technology

The set of findings analysed above invite reappraisal of the role of technological change in transforming work and employment. It is becoming increasingly apparent that its role is not crucial and that the potential of new technology may be put to use in extremely diverse ways. This does not mean to say that technology is a negligible factor: it opens up more avenues, seals off others, defines the limits of what is possible or probable, and often acts as a trigger for change.

Most authors underline that the factors that hinder the diffusion and use of technology over the short and medium term are due to lack of:

- -- Analysis of requirements, and prior thought given to equipment use and matching forms of work organisation;
- -- Consultation with the affected groups within an enterprise and proper information about forthcoming changes;
- -- Sufficiently early, complete and extended training (see below).

Employees react unfavourably to change the more they feel that it is forced on them along with a restrictive form of organisation that robs them of their independence. Such a solution serves the interests neither of corporate profitability nor of quality of life in the workplace as a number of case studies have shown. Also the management of small companies may be unable to cope with the mythical "microelectronics miracle" or understand the arguments put forward by the suppliers (European Centre for the Development of Vocational Training, 1984), and this too may lead to negative reactions.

Consequently, an increasing number of firms are investing more in prior study and overall plans for the use of new technology. Researchers and unions are suggesting approaches (job design, system design) for improving both job satisfaction and corporate profitability. Such approaches (13) may involve either informal consultation within the enterprise or formal negotiations. The law in certain countries requires enterprises to consult with, or at least inform, the trade unions or workers' organisations. The Scandinavian countries have been particularly vigilant in this respect but, even there, criticism has been levelled at the lack of worker consultation and the resulting under-use of equipment (perhaps the gap between expectations and reality is everywhere the same, except that in Scandinavia the expectations are higher) (14).

Much therefore remains to be done to improve the manner in which new technology is introduced, and to upgrade training. Training should be designed not only for users but also for the unions and the heads of small businesses, so that they are able to take a more informed and, if necessary, critical look at the possibilities and limitations of new technology.

Implications for training

The pivotal role of training is a clear consequence of the swift evolution and spread of new technology, all the more so since insufficient personnel training often subtracts from its efficient use. Again, changing recruitment patterns and promotion structures appear to give extra weight on the labour market to educationally acquired skills.

A crucial need therefore exists for a quantitative and qualitative assessment of training requirements. This need, however, is difficult to meet, insofar as:

- The rate of technological progress is such that acquired knowledge is quickly outdated;
- Forms of work organisation are increasingly fluid and flexible, as enterprises lay the stress on mobility. A main finding from this study shows also that organisational choices, with their contrasting effects on skills, remain comparatively open;
- A better understanding of methodological problems has pointed to the difficulties of forecasting "training needs" and their subjective character, not least since they are so closely linked to the supply of qualification offered.

For all of these reasons, and because the goals of training go beyond the mere satisfaction of economic needs, it seems unwise to think in terms of adapting training purely to technological change. In any case, advances in technology do not affect all sections of the population to an equal extent, and the number of jobs they create is limited. "It is a grave error of judgment to think that all ills will be cured by hitching education to the wagon of technological change." (15)

A distinction may also be made between training for computer specialists, for users, and for the general public, who are more and more influenced, directly or indirectly, by computerisation and automation. Whereas basic training is for the general public, we are particularly concerned here with vocational training intended for users. Of course, since countries and systems vary so widely, rather than attempt to describe all that has been undertaken in the field (16), we shall simply try to draw some general conclusions, based on the foregoing analysis, as to the part that training could play in the current process of change.

i) Basic education

Its role is essential, because:

- -- As cannot be stressed too often, it is the foundation for vocational training;
- -- We have shown that the qualities brought to the forefront by the changed nature of work (development of the capacity for logical, analytical, abstract thought) are not the fruit of specialised vocational training, but rather of general education;
- -- As new technology becomes more pervasive, the skills applied at work and in private life tend to converge (Hayes, 1980; Hebenstreit in Otway, 1983). Microcomputers and telecom systems are invading the home as well as the office;
- -- There is a serious risk that the spread of technology will widen the gap between those who have acquired the basic notions enabling them to adapt, and the rest, who will find themselves increasingly left behind.

These considerations have given birth to the attractive idea of generalising "computer literacy", either at school (as in the large project being carried out in France) or through a multi-media approach aimed at youth and adults (as in Great Britain).

While it is apparently logical to look at the school population first, as it is both easier to reach and more receptive, the approach raises a number of questions. Will computer science become a subject like the others? Will it be compulsory, optional, or taught to certain streams only? What will the subject content be?

A strong argument is that generalised instruction in computer-operating techniques, internal functioning and programming languages is less useful, because they evolve too quickly and are of less and less interest to non-specialists. As G. Schwartz in the United States (1984) writes, "Achieving computer literacy in the schools does not mean understanding bits, bytes and circuitry. It means understanding how a computer helps us think, analyse and solve problems, and see causes and effects." In other words, it is a matter of learning, not computer techniques, but rather:

- Computer logic and theory, based on algorithmic notions and programming; preferably accompanied by a critique pointing out the simplistic, or at least non-universal, character of the process;
- What computer science is; what it can and cannot do;
- What data entry, processing and storage signify (strict accuracy, reliability of data).

Obviously, learning can be aided by the use of the computer as a teaching tool. This question was studied at a recent OECD Conference (17) and we need not go into it here. It does suppose, however, that the means should not be mistaken for the end. It also supposes the availability of suitable programs and the training of teachers with this philosophy in mind -- neither of which, unfortunately, has been commonplace up till now. (G. Schwartz concluded the essay quoted above with the remark that "today's educators cannot teach this way".)

It remains to be seen whether the school system can absorb a change which modifies both the teacher's role and his relationship with the pupil. Experience with audio-visual techniques provides few grounds for optimism in this respect. National context is undoubtedly an important factor. If the schools cannot adapt themselves, they run the risk of being circumvented, of having part of their function taken over by the family and the workplace (Bertrand and Naymark, 1984).

Lastly, the subject should not be a separate discipline reserved for an élite and used, as mathematics often are, as part of a selection process. Algorithmic reasoning and the notion of programming could, in fact, be incorporated into all mathematics courses (Nivat, 1983).

ii) Initial vocational training

The first effect of extensive computerisation was to create a need for specialist training (programmers, systems engineers and analysts). Existing training structures had great difficulty in meeting this challenge. The need was to a large degree satisfied by non-formal educational offerings (courses organised by manufacturers, on-the-job familiarisation within the enterprise). Demand still remains strong and will no doubt remain so for a long time to come, but gradually the means to meet it have been assembled and the situation has become normal. Meanwhile, the level of computer expert training is rising and new specialities are being created.

The main problem now would seem to be user training. There is general agreement on the magnitude of the need but, because of the difficulties inherent in this type of evaluation and the indeterminate nature of the user category, it is almost impossible to estimate the need.

However, all young people with training for office work in the broadest sense of the term (accountancy, secretariat, administration), and, as time goes on, all who go into trade and services, may be considered as important future users.

The guidelines for general education already mentioned may also, in our opinion, be applied to initial vocational training. That is to say, rather than training in equipment handling or pure computer theory, what is needed is instruction in the ways computers can be used in the field covered by the particular course. In general, this means the ability to utilise the basic tools (e.g. files, spreadsheets, graphics, data banks, word processing -- for everybody, and not just secretaries). The possibilities and limitations of computers, especially in the specialty subject of the course, should also be taught. The idea is to train users to be adaptable.

There will naturally be differences in level, beginning with training in ordinary use. A higher level would prepare trainees to employ new programs (but not to devise them) and make them ready for future developments in computer systems. A yet higher level would enable trainees to act as interlocutors with computer experts, thus developing a kind of double-competence which is almost certain to be called for in the future.

On-the-job training should develop along the lines discussed in the chapter on changing skill patterns. In other words, it should aim from the outset at polyvalence and then develop awareness of the trainee's role in his enterprise, teach him how to deal with situations as they arise, and prepare him to solve problems. This also implies less specialised on-the-job training and development of aptitudes generally ignored by traditional training but made desirable by the new work patterns: adaptability and teamwork.

iii) Further continuing training and education

Preparation for technological innovation has up till now been carried out through continuing training. Most observers, however, have formed a rather grim opinion of the net result. For instance:

-- The training has rarely been given the attention it deserves;

-- The time spent on training is often too short;

-- Training is often of the on-the-job variety, purely practical and unplanned. "None of the courses gave a general overview or a conceptual understanding of the system" (Hingel, in CEC, 1982b). "A very narrow view of training has been taken by equipment suppliers" (Tarbuck, in Social Change, EEC, 1983;

-- Training, when it is less practical and more technical (understanding computer operations), often is not sufficiently tied into the field in which the trainees work. This leaves them unmotivated, or goes over their heads.

Under these conditions, new equipment is poorly used. The Association of Professional, Executive, Clerical and Computer Staff (APEX) (1980), considers, for instance, that three to five days only of training in word processing results in a degree of efficiency less than with old equipment. Short training may suffice for run-of-the-mill operations but leaves the user lost when a problem arises and it is of no value in preparing staff for future developments. Lastly, specialised training may be valid for one particular company only and thus limits the staff's future employment prospects. While this may suit the firm in the short view, it is neither in the general interest nor that of its personnel (Eksl, 1982).

Equipment manufacturers play an important part, as it is often they who provide training. Some of them bear responsibility for too short training time. Others are aware that good training is a necessary condition for efficient use of their machines, but the purchasing firms are not always ready to pay the price.

At the same time, there are signs that many enterprises are coming to grips with these problems. Several firms realise that better trained, more highly skilled staff form an important investment, besides being better able to adapt to change.

Hence, and in relation to what has been said above, further continuing training should respect the following principles:

a) Diversification, in view of the growing variety of hardware, fields of application and types of personnel involved. For instance, training a CAD user has little in common with training an office worker on word-processing (Hebenstreit in Otway, 1983).

b) Extending training more widely in order to reach beyond simple executants to medium-level professional staff and others involved indirectly in computer operations. A number of surveys have found, for example, that the writers of texts for word processing should receive training even if they do not use word processors themselves, so that they will work in better harmony with the secretarial staff (Manpower Services Commission, 1985).

c) Broadening the horizon beyond the immediate job context, and therefore giving some understanding of the organisational and economic setting, together with a glimpse perhaps of other subject areas. Broadening the horizon should also include technology not yet directly employed, but likely to be introduced in the near future (integrated office automation). This concern has to be carefully seen in relation to point a) above.

d) Strengthening of basic specialities -- the rigorous and systematic character of computer procedures can reveal shortcomings in professional methods and experience based on daily practice. It is therefore a matter of completing the knowledge of managers lacking in advanced training and improving the job training of employees so that they have a better command of their own techniques. In all cases, however, training must build on the experience acquired in the course of an often long career.

e) Imparting a "computer mentality", not to be confused with technical instruction. Where professional staff and managers are concerned, this means developing their ability to identify and express new needs in terms of information (Mandon and Rannou, 1983). Other users should be made aware of the needs and the constraints of information processing and taught to master computer operations in their special field.

f) Integration of theory and practice also becomes a necessity for a successful training programme, as has been shown in a number of case studies.

g) Participation of the firm's management staff in training operations would afford the best possible guarantee that they understand the problems from the user's point of view -- bearing in mind that the notion of job transferability is respected, and that the training is not made so specific that it cannot be used elsewhere.

h) Expansion and adaptation of training, which could consist of an introductory course, followed by supportive training on the job. This should ensure that more than just minimum operational knowledge is acquired. In this connection, a "training threshold" needs to be determined. "This important concept should be investigated in order to avoid an apparently adequate but poorly understood training blocking off the possibility of future advancement" (the case of word processing, Mandon and Rannou, ibid.).

i) Investing in training earlier on, that is to say, when new technology is being considered and not after the equipment has already been installed as, unfortunately, is too often the case.

Further Research

In the light of what has been said above, three observations can be made:

- The level of employment no doubt gives the gravest cause for concern. Overall econometric studies, however, because of problems of methodology, are clearly inadequate when it comes to quantifying the impact of the changes taking place.
- A qualitative approach is therefore necessary. In recent years, this type of approach has inspired a wealth of studies, focused mainly on the banking and insurance sector, secretarial and clerical work.
- While detailed studies are useful for understanding specific situations, they cannot -- to the extent that they deal with local, specific realities at a fixed point in time -- claim to represent general trends although a synthesis of a large number of them indicates some important general issues and trends.

Given the problem related to either strict macro-quantitative or strict micro-qualitative studies, it can be argued that future research should respect the following criteria:

-- Deal with sectors that have an important bearing on employment, particularly those where job creation is still possible;

-- Concentrate on the transformations that affect these sectors, examining not only technology but also management, organisation, job characteristics and status;

-- Adopt a dynamic and comparative viewpoint;

-- Deal with the problem of skill differentials.

Based on these criteria, it is possible to select some sectors which might warrant further study, namely:

-- The retail sector, affected by automation and computerised management and where old and new forms of work organisation compete together, with considerable implications for employment. The sector might be studied in chosen regions of the world. It might also be justified to return to the subject of banking and insurance in order to assess the extent of the particularly swift changes that they are currently undergoing.

-- Health, another source of job creation, but one where, as a result of growing social pressures and curtailment of resources, far-reaching changes are imminent; advanced technology, redistribution of tasks between medical and paramedical personnel and of treatment between hospital and home care, public sector and private practice, salaried practitioners and fee-charging professionals.

-- Business services, a statistically ill-defined category whose features are not well known. They have expanded as enterprises have farmed out more and more varied activities, with widely differing skill levels (from cleaning to consultancy and computer work).

-- Local government, which is taking on increasing importance in certain countries. It should be possible to study the competing logic of the public and private sectors (since financial belt-tightening is forcing the public sector closer to competitive attitudes).

-- Small business, so far less affected by computerisation and less closely studied than large firms, but on the whole a sector where employment growth takes place.

It could also be argued that attention should be paid to certain occupational categories increasingly affected by computerisation, such as middle-level executives and liberal professions. For the first time, the trend towards rationalisation is liable to affect their job content and threaten their privileged status, or indeed their jobs.

Studies focused on newly emerging occupations, even though they may not yet employ large numbers of people, would also be important to undertake.

NOTES AND REFERENCES

1. In 1979, Glenn and Feldberg pointed out that publicity for new computer equipment was then putting less emphasis on manpower savings than on other potential benefits (Zimbalist, 1979).

2. In France, around 1980, the Institut R. Genton estimated that six million white-collar workers were turning out ten billion original documents adding up to 28 billion pages intended for 40 billion addressees.

3. National Statement by Japan at the OECD Intergovernmental Conference on Employment Growth in the Context of Structural Change, February 1984.

4. This information is based on surveys carried out by T. Noyelle on the United States retail business in such stores as Sears, J.C. Penney's, Macy's and others.

5. Information on the Japanese telecommunications industry is partly based on personal conversations with the Director of Technology at the New York offices of the MITI.

6. Notably by CEREQ (1977), Missika (1981), Metzner and Rohde (1983), Arnold and Senker (1983), Eksl (1982) and Merchiers (1984).

7. In Europe, at least. Their appearance in Norway dates back to 1976, ten years after the United States (Schneider, 1982). In Great Britain, out of a sample of more than averagely advanced firms, 7 per cent had word processors in 1977 and 62 per cent in 1983, as against 89 per cent with computers in 1977 (Steffens, quoted by Tarbuck and Arnold in Senker, 1984).

8. See Monthly Labor Review, November 1983.

9. As, for example, when pool work is continued or revived.

10. Conversely, according to Les Puces (The Chips) (1982), typing speed is all the more appreciated (in Quebec) as other aspects of a typist's performance become less important.

11. Zisman, D., "Office Automation: Revolution or Evolution?" Sloan Management Review, Spring 1978.

12. Sorge, A., Hartmann, G., Warner, M., Nicholas, J., Microelectronics and Manpower in Manufacturing, Aldershot, Gower Press, 1983 (in German, Campus Verlag; in French, Revue Formation Emploi N° 2, 1983).
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13. See, for example, the works by E. Mumford (1983), Otway and Peltu (1983), Cooley for the International Metalworkers Federation (1984) and the report by P.L. Marger, Les enjeux de la formation professionnelle face aux mutations industrielles, Ministry for Vocational Training, Paris, 1984.

14. A.J. Hingel, in Nouvelles technologies et changement social.

15. Report by a team from France and Quebec, written up by P. Ratte, on "Education and the needs of society", COPIE programme (forthcoming).

16. See, however, A. Dirrheimer, Informatique et formation de main-d'oeuvre qualifiée dans le secteur des prestations de services, CEDEFOP, 1983.

17. International Conference on Education and New Information Technologies, OECD/CERI, July 1984. The conference dealt mainly with computer systems as an educational tool, but they were also discussed as a subject in their own right.

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